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Exchange Rates, Prices, and External Adjustment in the United States and Japan

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ABSTRACT

This paper studies the responsiveness of external balances--trade volumes and prices--to changes in exchange rates. Our objectives are twofold: to provide an analytical review of the literature in this area and to assess the influence of exchange rate movements on external adjustment in the two countries whose external imbalances have dominated all others over the past decade, the United States and Japan.

We find that the conventional partial-equilibrium model of the trade balance has performed generally quite well in predicting the path of the U.S. and Japanese external balance over the past decade. Second, in a partial-equilibrium setting, exchange-rate changes have a significant and substantial influence on movements in external balances. This view is supported by a massive empirical literature focusing on the estimation of price elasticities in trade, by casual inspection of the data, and by our own econometric estimates of trade elasticities. Third, Japanese real trade flows appear to be considerably less responsive to exchange-rate changes than U.S. real trade flows. This asymmetry can be traced only in part to evidence that Japanese exporters and U.S. exporters differ in the extent to which they pass-through exchange-rate changes to the foreign-currency prices of their exports. Finally, Japanese exporters tend to pass-through significantly less of any given percentage exchange rate change than U.S. exporters. Part of that difference is attributable to the greater sensitivity of Japanese production costs to exchange rate changes -- Japanese export prices fall when the yen appreciates, partly because the prices of petroleum and other imported raw materials in Japan tend to fall in proportion to the appreciation of the yen.

Exchange Rates, Prices, and External Adjustment in the United States and Japan

Peter Hooper and Jaime Marquez[1]

I. Introduction.

The experience of the past two decades of generally floating exchange rates among the major currencies has provided an excellent opportunity to observe and analyze movements in and interactions between exchange rates, prices, and external adjustment. The economics profession has not been timid in its response to this opportunity. A substantial and wide-ranging literature on the theoretical and empirical linkages between exchange rates and external balances has accumulated over the years. This paper focuses on a significant portion of that literature: the responsiveness of external balances--more specifically, trade volumes and prices--to changes in exchange rates. Our objectives are twofold: to provide an analytical review of the literature in this area and, drawing upon the most commonly used analytical approach, to assess the influence of exchange rate movements on external adjustment in the two countries whose external imbalances have dominated all others over the past decade, the United States and Japan.

With respect to our first objective, we have the luxury of being able to build on (and draw upon) several excellent surveys of various portions of

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the literature on exchange rates, prices and external balances. Goldstein and Khan (1985) provide a comprehensive review of work on income and price elasticities for international trade spanning much of the floating-rate period. Their survey is augmented by the contributions of Bryant et al. (1988), and Marquez (1993). Much of the emphasis of work in this area since Goldstein and Khan's review has been on the relationship between exchange rates and trade prices, or exchange rate "pass-through." Evidence of incomplete pass-through, or the existence of "pricing-to-market" behavior by firms engaged in international trade, has implied a weakening of the traditional linkage between exchange rates and trade volumes. Knetter (1992) provides a survey of a significant portion of the recent literature on pass-through.

In assessing the recent experience of the United States and Japan, we will be updating and extending a number of recent efforts to account for developments in the U.S. external balance by Bryant (1988), Cline (1989, 1991), Helkie and Hooper (1987), Hooper and Mann (1989), Krugman (1991), and Lawrence (1990), and in the Japanese external balance by Yoshitomi (1991).

To set the stage for our review and analysis, the relationships between exchange rates and trade prices and volumes are viewed as key parameters in what has become the textbook or "mainstream" macroeconomic model for analyzing external adjustment: the "expectations-augmented" Mundell-Flemming model.[2] Exchange rates are a primary endogenous channel through which changes in economic policies and shifts in intertemporal preferences

2. See Krugman (1991) for a verbal description of this model and Frenkel and Razin (1987) a more formal presentation. Frankel (1988) provides a helpful review of how most of the major global macro-econometric models in existence relate to this simplified two-country theoretical approach.

among private agents at home and abroad influence the external balance. Movements in exchange rates affect the external balance by altering relative prices and the allocation of expenditure and production across domestic and foreign goods. Our intent is to assess just how significant the exchange rate channel has been, correcting for other influences, especially during the period of floating exchange rates.[3] Typically, empirical estimates of these exchange rate parameters are derived in a partial-equilibrium framework that takes such endogenous variables as expenditures, output, and domestic prices as given. Our survey focuses primarily on this partial-equilibrium framework.

Our review of the literature begins in section II with a presentation of the standard theoretical approach to modeling of trade volumes and prices in a partial-equilibrium framework of demand and supply for imperfect substitutes. The recent innovations to theory that we consider are largely on the supply side, particularly in the area of exchange rate pass-through. We do not address the intertemporal approach to the external balance, which is covered elsewhere in this volume, although the partial-equilibrium parameters we consider could easily be imbedded in a general-equilibrium intertemporal model (see Razin 1993). In section III, we survey empirical estimates of the price elasticities of demand for real exports and imports and estimates of the

3. Strictly speaking, we assess the extent to which movements in exchange rates, whatever the cause, influence the external balance through their effects on the prices and relative prices of imports and exports. In principle, the exchange rate can also influence the external balance through the effects of a change in the terms of trade on real income and expenditures--the "Harberger-Laursen-Metzler effect." Obstfeld (1982), Svensson and Razin (1993) and others have noted that the theoretical effects are ambiguous, depending on the persistence of the exchange rate shock. More recently, Mendoza (1992) has found some empirical evidence to suggest that the effect may be significant for countries that are open to large and sustained exchange rate shocks.

effects of exchange rate changes on import and export prices. Our survey is limited to studies that employ conventional trade-model specifications that yield readily identifiable price elasticities and/or pass-through coefficients; we do not include, for example, recent studies by Rose and Yellen (1989) and others that have estimated reduced-form equations for the trade balance.[4] While much of the literature has focused on empirical estimates specific to the United States, we also devote some attention to studies that have addressed estimates for Japan.

Our analysis of the extent to which movements in exchange rates have contributed to external adjustment since the early 1980s is presented in Section IV. We begin with a review of the data, then estimate trade equations using both standard and nonstandard specifications, and finally use simulation analysis to illustrate the partial-equilibrium influences of exchange rate changes. This analysis focuses on the experience of the United States and Japan. Our conclusions and suggestions for further research are presented in Section V.

4. Several recent studies, by Rose and Yellen (1989) and Rose (1990, 1991), among others, have investigated the sensitivity of trade to exchange rates in single-equation models of the trade balance, and their results have challenged the prevailing view that exchange rate changes have potent effects on external balances. Specifically, for the United States and several other industrial countries, Rose and Yellen find little empirical support for a causal relationship running from the real exchange rate to the real trade balance in the long run. However, Meade (1992) has found that many of Rose and Yellen's results are reversed when alternative data sources, different estimation periods, and/or small changes in empirical specification are incorporated.

II. Analytical Framework.

To assess the linkages between exchange rates on the one hand and external balances and trade prices on the other, we begin with the conventional partial-equilibrium demand-side approach to modeling real trade flows.[5] We then extend the conventional theoretical analysis to incorporate a review of recent work on the supply side dealing with the issue of exchange rate pass-through.

A. Demand.

Conventional Model of the Real Trade Balance. At the most basic level of analysis, the model assumes two countries, each producing a single tradable good which is an imperfect substitute for the good produced in the other country.[6] Consumers in each country consume both goods and allocate their current nominal expenditures (Y and Y^*) between quantities of the two goods produced (Q and Q^*), given the prices of those goods, P and P^*, so as to maximize their utilities.[7] Prices of the two goods are assumed to be sticky,

5. Good background expositions of this approach and how it fits into the more general two-country model can be found in Kenen (1985), Krugman (1991), and Caves, Frankel, and Jones (1993).

6. The alternative assumption of perfect substitutes, which implies the "law of one price," has been rejected by the data. Wide swings in the relative price indexes for manufactured goods over the past two decades have indicated that the law of one price fails at the macro level. Moreover, various studies, including Isard (1977), Kravis and Lipsey (1978), and Giovannini (1988), have shown that outside the markets for basic raw commodities, which account for a relatively small portion of total trade, the law of one price fails to hold for a wide range of narrowly defined classes of goods. See Goldstein and Kahn (1985) for a discussion of both the imperfect substitutes and perfect substitutes models.

7. While theory dictates that wealth or current expenditures is the appropriate scale variable the import demand equation, most of the empirical studies we survey later employ current GDP. A theoretical case can be made for using output instead of expenditures as the scale variable inasmuch as a

(Footnote continues on next page)

and, for the time being, are taken as given with respect to external demands. The home country's demand for foreign goods (DQ^*) is a function of home expenditures and the prices of the two goods expressed in units of home currency:

(1) $$DQ^* = f(Y, P^*/S, P),$$

where S is the nominal spot exchange rate in terms of foreign currency per unit of home currency, and $f_1 > 0$, $f_2 < 0$, and $f_3 > 0$ with f_i denoting the partial derivative of $f(\cdot)$ with respect to the ith argument. Assuming that (1) is homogeneous in prices and nominal expenditures yields

(2) $$DQ^* = f(y, P^*/S \cdot P),$$

where $y = Y/P$. Similarly, the foreign country's demand for home goods (D^*Q) is a function of foreign real expenditures and the relative prices of the two goods expressed in units of foreign currency:

(3) $$D^*Q = f^*(y^*, S \cdot P/P^*),$$

where $f_1^* > 0$, and $f_2^* < 0$. The home country's external balance can be written in real terms as the difference between the quantity of exports and the quantity of imports:[8]

(4) $$D^*Q - DQ^* = nx(y, y^*, S \cdot P/P^*),$$

where $nx_1 < 0$, $nx_2 > 0$, and $nx_3 < 0$; the trade balance in nominal terms is

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(Footnote continued from previous page)
good deal of world trade takes place in intermediate goods and raw materials. In any event, Hooper and Mann (1989) find that it made essentially no difference empirically whether one uses domestic expenditures or GDP to model aggregate U.S. import demand.

8. "Quantities" are generally measured in terms of units of currency valued at constant prices for some base year; prices are indexed to the same base year.

(5) $P \cdot D^{*}Q - (P^{*}/S)DQ^{*} = nxv(y,\ y^{*},\ S \cdot P/P^{*},\ P,\ P^{*}/S).$

At this highly simplified level, the ratio $S \cdot P/P^{*}$ can be viewed, alternatively, as the relative price of exports, the inverse of the relative price of imports, the terms of trade, and the real exchange rate. (Appendix A outlines how these different measures of relative prices or real exchange rates are related to one another under more realistic assumptions; in Section IV we consider how much the various measures differ empirically.) With sticky prices, a movement in the nominal exchange rate S (e.g., induced by a shift in one country's economic policies) will affect relative prices and the external balance.[9]

Introduction of Non-Traded Goods. The model becomes more complex when we allow for non-traded goods as well as traded goods. We continue to assume that traded goods produced in both countries are differentiated, but in this case, the price terms P and P^{*}, which in equations 1-5 referred to the prices of traded goods only, we now relabel as P_T and P_T^{*}. And P and P^{*} become indexes of the prices of tradables and nontradables:

(6) $P = \tau P_T + (1-\tau)P_N,$

and

(7) $P^{*} = \tau^{*}P_T^{*} + (1-\tau^{*})P_N^{*},$

where τ and τ^{*} are the shares of tradable goods in expenditures at home and abroad.

The home country's import demand is now written:

(8) $DQ^{*} = Q_m = f(y,\ P_T^{*}/SP),$

9. In the presence of fully flexible prices, of course, shifts in national currencies or nominal exchange rates would not influence relative prices.

where Q_m is the quantity of goods imported. Similarly, the demand for exports is written:

(9) $$D^*Q = Q_x = f^*(y^*, S\bullet P_T/P^*).$$

In this case, the real trade balance is written as a function two expenditure terms and two relative price terms:

(10) $$Q_x - Q_m = nx(y, y^*, S\bullet P_T/P^*, P_T^*/S\bullet P).$$

The nominal trade balance is written:

(11) $$P_TQ_x - (P_T^*/S)Q_m = nxv(y, y^*, S\bullet P_T/P^*, P_T^*/S\bullet P, P_T, P_T^*/S).$$

Assuming, for the moment, that the prices of tradable goods are fixed in the currency of the exporting country and not immediately influenced by movements in exchange rates, the effect of the exchange rate on the nominal trade balance depends on three factors. The first is the price responsiveness of real imports, Q_m, which is defined in elasticity form as

(12) $$\eta_p^{dm} = \partial\ln(Q_m)/\ \partial\ln(P_T^*/S\bullet P),$$

and is expected to be negative. The second is the price responsiveness of real exports, Q_x, which in elasticity form equals

(13) $$\eta_p^{dx} = \partial\ln(Q_x)/\ \partial\ln(S\bullet P_T/P^*) < 0.$$

The third is the valuation effect induced by the change in the exchange rate. Specifically, as equation (11) indicates, changes in the price of imports, P_T^*/S, and therefore the value of imports, $(P_T^*/S)Q_m$, rises in proportion to a depreciation of the home currency (decline in S).

<u>Marshall-Lerner Condition</u>. The Marshall-Lerner (M-L) condition holds that a depreciation of a country's currency will increase its nominal balance of trade if the sum of its price elasticities (with signs reversed), $-(\eta_p^{dm} + \eta_p^{dx})$, exceeds 1.0. That is, the real trade balance must rise enough to offset the direct effect of the depreciation on the value of imports. This condition

assumes that the trade balance is zero initially. If the trade balance is in deficit, and the price elasticity of imports (with sign reversed) is less than 1.0, the elasticities will have to sum to more than 1.0 for a depreciation to raise the nominal trade balance. For example, if imports are twice as large as exports and the price elasticity of imports is zero, the price elasticity of exports (and therefore the sum of the elasticities, with signs reversed) would have to be 2.0 in order for real exports to rise enough to offset the increase in the value of imports associated with the depreciation. Similarly, if the trade balance is in surplus, the condition can be met with elasticities summing to less than one.

The Marshall-Lerner condition also assumes that the elasticities of supply of traded goods are infinite and that their prices are fixed in terms of the exporting country's currency. If the prices of traded goods respond to the exchange rate change, the trade balance could improve even if the price elasticities of demand sum to less than 1.0 (in absolute value). That is, if the import price (P_T^*/S) rises by less than the full amount of the depreciation, a smaller improvement in the real trade balance is needed to offset the rise in the value of imports.

Dynamics, the "J-Curve," and other Issues. To this point, we have treated import and export demand in an essentially static framework and have abstracted from dynamics in the adjustment of demand to changes in prices. In empirical models, exchange rates changes typically affect import prices before trade quantities begin to respond to the relative price changes, producing the familiar "J-curve" pattern of response in the trade balance to a depreciation.[10] The trade balance follows a "J" pattern (relative to its baseline path) because the price and value of imports rise first, causing the trade balance to fall initially. Thereafter, the trade balance rises gradually as real net exports respond positively over time to the changes in relative prices. The Marshall-Lerner condition is based on long-run elasticities, after all adjustment lags have been worked through. As discussed below, trade prices may respond with a lag to exchange rate changes. Once prices have changed, lags in the response of real trade flows can reflect such factors as recognition-response lags, contract lags, and order-delivery lags.

We should also note that empirical trade models increasingly have included in structural trade volume equations cyclical demand or non-price rationing and secular supply variables (relative capital stock or time trend) variables. Non-price rationing refers to rationing techniques such as changing order backlogs, delivery times, promotional effort, and so on, that firms may turn to before altering their prices in the face of a shift in demand (see Gregory, 1971). Secular supply variables are discussed further below. While the inclusion of such variables has been found to have a significant effect on estimated income elasticities, they generally have negligible effects on estimated relative price elasticities. See Hooper (1989), Marquez and Ericsson (1993), and Blecker (1992).

10. See, for example, Meade (1988), Moffet (1989), Marquez (1991) for a more detailed discussion of the J-curve.

B. Supply and Price Determination.

The importance of supply and the endogeneity of import prices with respect to import demand has been recognized at least since the work of Orcutt (1950). Nevertheless, as noted by Marquez (1993), the vast majority of empirical studies in this area have continued to assume that prices can be determined independently of demand. This independence is based in some cases on the assumption that foreign export suppliers are perfectly competitive with constant returns to scale, which yields a perfectly elastic export supply curve. In other cases, the importance of noncompetitive markets is recognized, but prices are determined quasi-independently of import demand in price-markup equations.

We begin this section with a brief review of the mark-up equation approach to modeling import prices that has been employed in conventional trade models. Then we turn to the literature on exchange rate pass-through that has focused more specifically on the relationship between exchange rates and import and export prices.

Mark-up Equations. The markup equation approach draws on price models developed by Eckstein and Fromm (1968) and Dixit and Stiglitz (1977). This approach has been applied to import price determination by Clark (1974), Helkie and Hooper (1988), Hooper and Mann (1989) and others. Typically, import prices expressed in terms of the exporting country's currency, are set at a markup over foreign costs (C^*):

(14) $$P_T^* = \lambda(C^*).$$

The markup factor, λ, is a function of the excess demand or capacity utilization of the exporter (CU^*), and, assuming some degree of pricing-to-market behavior by the exporter (described in more detail below), the domestic price in the import market:

(15) $\lambda = g(CU^*, S \cdot P_T)$.

Substituting (15) into (14) yields:

(16) $P_T^* = g(C^*, CU^*, S \cdot P_T)$.

Some studies (Helkie and Hooper, for example) have argued that because differences between the volatility of exchange rates and domestic prices or production costs, proportional changes these variables may not have identical effects on import prices. A more general form of (16), therefore, is:

(17) $P_T^* = g(C^*, CU^*, S, P_T, \ldots)$,

where $g_1 > 0$, $g_2 > 0$, $g_3 > 0$, and $g_4 > 0$.

Exchange Rate Pass-Through. The markup approach to import price modeling has been augmented by a substantial and growing literature on import price determination that has focused on the issue of exchange rate pass-through. Early on, this work focused on the case of perfect competition with less than perfectly elastic supply. More recently, the literature has concentrated on various models of imperfect competition, including both static profit maximization by firms with monopoly power and dynamic models of pricing-to-market behavior.

Before surveying this work, we begin by defining terms. Pass-through is generally defined as the ceteris-paribus responsiveness of a country's import prices to changes in its exchange rate against other currencies. For the moment, we follow the presentation in earlier sections and specify the import price, P_m, as:

(18) $P_m = P_T^*/S$.

The rate of exchange rate pass-through, φ, is defined as:

(19) $\varphi = \partial\log(P_m)/\partial\log(S) < 0.$

If, for example, a ten percent depreciation of the dollar (decline in S) raises U.S. import prices by 6 percent, then 60 percent of the depreciation is said to have been passed through, i.e., $\varphi = -0.6$. Full (100 percent) pass-through would imply $\varphi = -1.0$.

From equation (18), it can be seen that to the extent that the depreciation is not fully passed through to higher import prices, it must be absorbed into lower foreign prices (P_T^*). This effect can be shown more rigorously by taking the log of equation (18), differentiating the result, dividing through by $\partial\log(S)$, and rearranging terms to obtain:

(20) $$\partial\log(P_T^*)/\partial\log(S) = \partial\log(P_m)/\partial\log(S) + 1 = \varphi + 1.$$

Continuing with our earlier example, if pass-through is 60 percent ($\varphi = -0.6$), a 10 percent depreciation implies that the foreign price declines $\varphi + 1$ (= 0.4) times 10 percent, or 4 percent.

<u>Static Models</u>. A variety of theoretical models have emerged to explain the lack of complete pass-through. Early work on pass-through appeared in the wake of currency realignments and the depreciation of the dollar in the early 1970s as the Bretton Woods System gave way to floating exchange rates. Branson (1972), using an equilibrium demand and supply model in the spirit of Kindelberger (1963) and Haberler (1949), showed that pass-through is less than complete if the price elasticity of the supply of exports is less than infinite, as would be the case for large countries.

Specifically, he showed that under perfect competition and with constant elasticities of demand and supply the pass-through coefficient is defined as

(21) $\varphi = -1/(1 - \epsilon/\delta)$,

where ϵ is the price elasticity of demand for imports (assumed to be negative) and δ is the price elasticity of supply for imports (assumed to be positive). It can be seen from equation (21) that when supply is infinitely elastic, pass-through is complete ($\varphi = -1$). Moreover, the smaller the elasticity of supply and the greater the elasticity of demand, the less the degree of pass-through coefficient (i.e., φ approaches zero). The intuition behind this result is that as a depreciation of the importing country's currency raises the import price, import demand shifts down to the left along an upward sloping foreign export supply curve, causing the foreign export price to fall. The steeper the supply curve and the flatter the demand curve, the greater the decline in the foreign price, P_T^*, and the less the pass-through of the depreciation to import prices.

Interest in the issue of pass-through was sparked again by the U.S. experience of 1985-87, when the dollar depreciated sharply but import prices rose only relatively moderately. The recent work on pass-through has focused on various models of imperfect competition. Most studies have adopted the approach of static profit maximization by firms with some degree of monopoly power, stemming from, for example, product differentiation or oligopolistic market structure.

Profit maximization by the representative foreign exporting firm is written as

(22) $\underset{Q_m}{\text{Max}}\ Q_m[S \cdot P_m] - C^*(W^*, S \cdot P_r, Q_m)$,

where the exporting firm's profits (in its own currency) are equal to the quantity sold times price the firm sets in the import market translated to its own currency minus its costs of production. We assume that costs depend on the wage rate (W^*), the domestic-currency price of raw material inputs, $P_r^* = S \cdot P_r$, where P_r is the international (dollar) price of raw materials, and (given non-constant returns to scale) the quantity produced (Q_m).

The first-order condition of (22) is

$$(23) \qquad S \cdot P_m(Q_m;\ y,\ P)(1 - 1/\eta) - \partial C/\partial Q_m = 0,$$

where $P_m(Q_m;\ y,\ P)$ is the inverted import demand function (solved for price) and $\eta = -(\partial Q_m/\partial P_m)(P_m/Q_m)$ is the associated price elasticity of demand with its sign reversed. Let $Q_m^o = Q(S,\ W^*,\ P_r)$ be the optimal or profit-maximizing level of production associated with (23); substituting Q_m^o into the inverted import demand equation yields a reduced-form equation for import price:

$$(24) \qquad P_m = P_m(W^*,\ P_r,\ S,\ y,\ P).$$

To derive the coefficient for the pass-through of exchange-rates to import prices, φ, we follow Branson and Marston (1989), Feenstra (1989), and Knetter (1992) by totally differentiating the first-order condition (23) and rearranging terms to obtain:

$$(25) \qquad \varphi = d\log(P_m)/d\log(S) = -[(\eta-1) - \eta\mu/P_m)]/[(\eta-1) - \eta_q - \theta\eta/S(\partial P_m/\partial Q_m)]$$

where, η is the price elasticity of demand (with sign reversed) as defined earlier, and

$\eta_q = d\log(\eta)/d\log(Q_m)$ is the derivative of the elasticity of demand with respect to quantity or the curvature of the demand schedule.

$\theta = (\partial^2 C/\partial Q_m^2)$ is the derivative of marginal cost with respect to output or the degree of returns to scale.

$\mu = (\partial^2 C/\partial Q_m \partial P_r^*)P_r[(\partial P_r/\partial S)(S/P_r)+ 1]$ is the product of the derivative of marginal cost with respect to raw material prices, $(\partial^2 C/\partial Q_m \partial P_r^*)$, and the derivative of the exporter's price of raw materials with respect to S, $P_r[(\partial P_r/\partial S)(S/P_r)+ 1]$.[11]

$\partial P_m/\partial Q_m$ is the slope of the demand curve and is negative.

Pass-through will be complete or 100 percent if the elasticity of demand is constant (i.e., $\eta_q = 0$), if marginal costs (or returns to scale) are constant (i.e., $\theta = 0$), and if raw material prices in the exporting country are unaffected by exchange rates (i.e., $\mu = 0$). In this case, (25) simplifies to

$$(26) \qquad \varphi = -(\eta-1)/(\eta-1) = -1.$$

It can also be seen from (25) that pass-through will be less than complete (that is, $-1 < \varphi < 0$) under any of several conditions. One condition

11. The latter derivative is obtained by differentiating ($P_r^* = S \cdot P_r$) with respect to S. The result is equal to P_r times the quantity 1 plus the elasticity of P_r with respect to S.

is decreasing returns to scale ($\theta > 0$): the intuitive explanation for this result is that a depreciation (decline in S), for example, reduces import demand, which in turn reduces the exporter's unit costs, causing the marked-up price to rise less than proportionately to the exchange rate. A second condition is if the the exporter's production costs are sensitive to the decline in S through its negative effect on raw material prices in the exporter's currency ($\mu > 0$).[12] A third condition involves the response of the price elasticity of demand to changes in quantities sold. If the price elasticity of demand increases in response to lower sales, profit-maximizing producers will raise their prices less than otherwise. Pass-through could conceivably be greater than 100 percent if returns to scale were increasing or if the price elasticity of demand declined in response to lower sales.

The monopolistic approach to pass-through has been adopted by Mann (1986), Dornbusch (1987), Krugman (1987b), Giovannini (1988), Branson and Marston (1989), Feenstra (1989), (Murphy (1989), Ohno (1989), Marston (1990), Gagnon and Knetter (1992), and Knetter (1992), among others, though with variations on the basic model. Dornbusch, Krugman, Murphy, and Ohno assume constant marginal costs and non-constant elasticity of demand, while the other studies allow for increasing marginal costs. Ohno, Branson and Marston, Marston, and Hooper and Mann (1989), take into account the role of raw material prices in reducing pass-through, while the other studies do not.

12. This condition will hold unless either marginal costs are unresponsive to raw material prices or the exporter's raw material prices (P_r^*) are unresponsive to exchange rate changes. It can be seen from the second term in the definition of μ that P_r^* would be unaffected by S only if the elasticity of P_r with respect to S is -1 (that is, if international prices of raw materials in dollars respond inversely proportionately to changes in S).

Giovannini, Knetter, Marston, and Ohno consider the case of a firm that sells in more than one market; this generalization allows for more explicit analysis of pricing-to-market behavior or price discrimination across markets (a primary focus of Marston's analysis), but it does not alter the basic insights about pass-through derived from equation (25). Strictly speaking, pricing to market is a special case of incomplete pass-through; it requires some degree of market segmentation that allows firms to set prices differently in different markets. In this case, the exporting firm determines not just one price (P_T^*), but multiple prices, each dependent on the demand conditions in a specific market.

Some researchers have modeled pricing-to-market behavior by appealing to alternative market structures that highlight strategic pricing behavior by firms. Dornbusch (1987), Krugman (1987b), Fisher (1987), and Knetter (1992) consider oligopoly markets, where a firm's maximizing decision is directly affected by the prices of its competitors, and where the degree of pass-through depends on the degree of market concentration.[13] One drawback to the oligopoly approach is that it is usually based on the assumption of homogeneous products, whereas most international trade takes place in differentiated products.

Dynamic Models and Hysteresis. The studies of pricing behavior we have surveyed thus far consider primarily longer-term, static explanations for incomplete pass-through and pricing to market, relating to market structure. Giovannini (1988) and Feenstra (1989) introduce a dynamic element into their

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13. In addition to considering alternative market structures, Fisher addresses the issue of exchange rate expectations and how alternative expectations hypotheses can can interact with alternative assumptions about market structure to influence the rate of pass-through.

analytical framework by assuming that exporting firms maximize expected future profits and must deal with exchange rate uncertainty. Giovannini finds that with prices set in advance, pass-through depends on the currency-denomination of contracts and the distribution of exchange rate movements. The upshot is that transitory movements in exchange rates are passed through less than permanent ones. In Feenstra's empirical implementation of a similar model, expectations are formed on the basis of current and lagged values of exchange rates. Ohno (1989) introduces dynamic adjustment into the price equation by assuming the existence of contract lags; exchange rate changes are passed through gradually over time as contracts expire.

Several other studies have focused more comprehensively on short-term, dynamic explanations for pricing-to-market behavior. Krugman (1987b) notes that pricing to market can occur in the face of temporary swings in exchange rates in the presence of significant costs of adjustment. Krugman and Baldwin (1987) and Baldwin (1988a) use a monopolistic competition framework and Dixit (1989a) a competitive market framework to argue that the existence of significant fixed costs to market entry can lead to substantial differences in pass-through behavior for large versus small changes in exchange rates. For a given market structure, a small appreciation of the home currency, for example, may result in moderate (or no) pass through to lower import prices, which would be reversed when the appreciation was reversed. In the case of an appreciation that is large enough to overcome the fixed costs of entry, however, additional foreign firms will be drawn into the home market, increasing competition, pushing down prices, and resulting in pass-through (to lower import prices) that is proportionately greater than in the case of a small appreciation. The change in market structure following the large appreciation will alter the pass-through coefficient for small exchange rate changes. That is, with profit margins reduced as a result of the new entrants, small exchange rate changes will be passed-through more than previously. Moreover, when the large appreciation is reversed, the desire not to give up the sunk costs of entry will keep firms from leaving the market and will result in less pass-through than during the appreciation. This pass-through asymmetry produces "hysteresis" in import prices: a large appreciation that is subsequently reversed leaves import prices permanently lower than they would have been if the swing in exchange rates had not taken place.

In a related study, Froot and Klemperer (1989) postulate an oligopolistic model in which firms' future demands depend on their current market shares (via brand loyalty, and so on). This intertemporal dependence implies that pass-through will vary (and can result in hysteresis in import prices) depending on whether an exchange rate change is expected to be transitory or permanent. In the face of transitory changes in exchange rates, firms are willing to absorb transitory exchange rate changes into (or out of) their current profits (i.e., they price to market) in order to maintain their current market shares and future sales. In the case of permanent changes, however, competitive pressures force more complete (and immediate) pass-through of the exchange rate change. The effects of transitory versus permanent changes in exchange rates when market share matters are therefore analogous to those of small changes versus large changes in the presence of entry costs. Kasa (1992) develops a dynamic model of a price-setting firm selling in two markets thta incorporates the elements of both the supply-side (adjustment cost) dynamics postulated by Baldwin and the demand-side a-la Froot and Klemperer.

The primary implication of dynamic considerations (including both expectations and contracts) for the specification of trade price equations and pass-through coefficients has been to incorporate distributed lags into the equations. Froot and Klemperer treat expectations in a more forward-looking context, however, by using both forward exchange rates and survey data on exchange rate expectations.

Exchange Rates and Supply in the Long Run. Other research has considered the possibility that firms will shift not only sales and distribution networks in response to large exchange rate changes, but also the location of their production facilities. If nominal wages are sticky, labor is relatively immobile across countries, and capital and labor are compliments in production, movements in exchange rates may alter relative labor costs across countries enough to induce shifts in the location of productive capital. Hooper (1989) found some evidence to support this hypothesis, indicating the possibility that exchange rates have a much longer-term partial-equilibrium effect on external balances than suggested by normal lags on partial-equilibrium price elasticities.[14] In particular, he found that the long-term downtrend in the ratio of the U.S. manufacturing capital stock to that in other OECD countries was interrupted (and partially reversed) during the latter 1970s after a significant depreciation of the dollar pushed manufacturing unit labor costs in other G-10 countries on average above those in the United States. The downward trend in the ratio of capital stocks resumed when the appreciation of the dollar during the first half of the 1980s

14. Several other studies, including Caves (1990) and Froot and Stein (1991), have investigated the effect of exchange rate changes on direct investment, but these studies have focused on the financial flows associated with direct investment rather than the location of actual plant and equipment.

moved U.S. unit labor costs back above the average foreign level. Hooper predicted that in the wake of the sharp decline in the dollar through 1987, relatively attractive labor costs in the United States, ceteris paribus, would again reverse the downtrend in the capital stock ratio. This prediction was not realized, however, at least until cyclical recovery in the United States coincided with economic downturns aborad during 1992.

While the possibility of a longer-term link between exchange rates and trade flows through investment/supply-side developments may warrant further investigation, this link is clouded by several factors. One is that the decisions of firms about where to locate production facilities is based on much more than just relative labor costs. A domestically-generated investment boom in Japan and stimulus to investment in Europe stemming from EC-92 caused the ratio of the U.S. to foreign capital stocks to continue on a strong downward trend during the latter 1980s despite a substantial decline in U.S. relative unit labor costs. A second factor is that even after the sharp depreciation of the dollar through 1987, U.S. unit labor costs remained far above those in most developing countries, and the U.S. capital stock seemed likely to continue to decline relative to capital stocks in those areas. Third, a currency depreciation would have a significant positive effect on the external balance in the longer term through this channel only if it were accompanied by (or induced by) a shift in policies or private preferences that led to an increase in domestic saving relative to domestic investment.

Movements in the capital stock ratio may have implications for views about the longer-term trend in the dollar's equilibrium real exchange rate. As Krugman (1987d, 1989) has noted, the "Houthakker-Magee result," which finds that the income elasticity of U.S. imports is substantially greater than that of U.S. exports, implies a secular downward trend in the dollar's longer-term equilibrium real exchange rate. That is, the elasticity differential implies that if incomes in the United States and elsewhere expand at comparable rates over the long term, the U.S. trade deficit will widen continuously unless the dollar depreciates. Helkie and Hooper (1988) and Hooper (1976, 1989) have argued that the estimated gap in income elasticities reflects, at least in part, secular trends in missing supply factors that are correlated with longer-term trends in income variables. Rapid growth in U.S. imports over the past two decades relative to growth in U.S. income has not necessarily reflected a high income elasticity of U.S. demand for the types of goods that are being imported. Much of that growth has instead reflected the emergence of new suppliers abroad. In principle, supply increases abroad should be reflected in declines in the U.S. import price. However, as Feenstra (1992) has noted, existing aggregate price indexes do not adequately capture the introduction of new products (or of existing products by newly supplying countries) and may well be biased upward as a result.

Helkie and Hooper, in their various studies, have attempted to correct for the possible bias in relative prices and estimated income elasticities by including relative private capital stocks directly in import and export demand equations as proxies for the missing supply factors. They find that inclusion of the relative capital stock variable significantly reduces (and in some cases actually eliminates) the difference in income elasticities between U.S. imports and exports, without having much effect on estimated price elasticities.[15] This finding has important implications for the simulated trade effects of shocks to income, but the implications for a possible secular downtrend in the dollar is moot if the the longer-term trend in the relative capital stock variable persists.

III. Survey of Empirical Studies

This section reviews econometric estimates of the price elasticities of demand for exports and imports and the pass-through of exchange rate changes to trade prices.

Price Elasticity Estimates. Over the post-war period, a large number of empirical studies, encompassing a wide variety of theoretical models and estimation techniques have reported estimates of price elasticities in trade. The intent of this section is to attempt to distill the results of a significant portion of these studies into "consensus" estimates, and to note how these estimates are affected by alternative estimation techniques. While our survey is wide-ranging, we have limited our selection in several respects to keep it manageable. First we focus on estimates that are based on some variation of the conventional theoretical (imperfect-substitutes) model described in the preceding section. Second, we consider only studies that assume constant elasticities (i.e., that use a log-linear functional form). Third, we limit our review to studies that report elasticities for aggregate

15. Specifically, they find that the foreign fixed private capital stocks generally have grown faster than the U.S. capital stock, consistent with an increase in relative supply of foreign goods and a decline in the relative price (if it were measured correctly) of those goods. Adding the capital stock variable to the trade equations results in lower estimates of the income elasticity of U.S. imports and somewhat higher estimates of the income elasticity of U.S. exports.

trade flows, whether or not they were estimated directly from aggregate trade flows. However, we also briefly mention some of the types of studies that are excluded by these criteria. Previous, and in some cases more broadly encompassing, surveys of price elasticities than our own are provided by Stern et al. (1976), Goldstein and Khan (1985), Kohli (1991), and Marquez (1993).

Our selection criteria still allow for considerable variation in theoretical and empirical approaches to estimation of price elasticities (and we do not claim to be exhaustive in our coverage of this class of studies).[16] The key differences that we try to account for across studies include whether or not price-homogeneity is maintained, the sample period of estimation, the periodicity of the data (annual versus quarterly), the estimation technique (single-equation with prices treated exogenously, or one of several possible simultaneous estimation techniques with prices treated endogenously), the degree of commodity disaggregation (inclusion and exclusion of oil), and the treatment of adjustment lags (Almon lags, Shiller lags, lagged dependent variables, or no lags).[17] Some of the differences across studies that we have not attempted to account for include differences in data used for prices, income and so on, differences with respect to aggregation or disaggregation of trade flows by region, differences in the method of aggregation across foreign

16. In particular, a large number of unpublished studies have eluded our net.

17. If $y_t = \Sigma_i \beta_i X_{t-i}$, then using Almon lags amounts to assuming that the β_is lie on a polynomial curve. In the case of a second-degree Almon lag, for example, the lag coefficients, β_i, are defined by the quadratic equation: $\beta_i = \alpha_0 + i\alpha_1 + i^2 \alpha_2$. Shiller lags assume that the polynomial is not known precisely. For the previous example, $\beta_i = \alpha_0 + i\alpha_1 + i^2 \alpha_2$ + random disturbance.

countries, and differences in the inclusion of additional determinants of demand (non-price rationing variables, and so on).[18]

Table 1 lists 37 studies and their estimates of the long-run price elasticities for key industrial countries: Canada, Germany, Japan, the United Kingdom, and the United States.[19] Most of the studies reported estimates for the United States; several reported results for all five countries. The table also indicates key attributes of these studies, pertaining to (1) the presence or absence of homogeneity constraints, (2) estimation method, (3) dynamic structure, (4) data frequency and sample period, (5) country, (6) long-run price elasticity estimates for exports and imports, (7) exchange-rate system, and (8) the degree of commodity disaggregation.[20] Definitions are presented at the end of the table. With respect to the designation of exchange rate system, many of the studies we have included are based largely on data that pre-date the floating exchange rate period. These studies were included to

18. Some of these measurement issues are discussed in the next section and in Appendix A. Other related measurement issues are considered at length in Hooper and Richardson (1991).

19. The long-run elasticities measure the full effects of a change in relative prices after all lags have been worked through.

20. The elasticity estimates reported in Table 1 are "own price elasticities." This distinction is important for studies that estimated bilateral trade equations in a regionally-disaggregated framework. Several of those studies, by Magee (1972), Geraci and Prewo (1982), Cline (1989), and Marquez (1990), included cross-price elasticities ("third-country" competitive effects) in addition to own price elasticities. In most cases the cross-price elasticities for total trade by region are not significant (see Marquez for example). Cline reports sizable cross-price effects, but in a large majority of cases, those elasticities were imposed by constraints used in estimation rather than freely estimated. Our own estimates, reported in the next section are designed to capture third-country competitive effects to some degree by using multilateral trade shares rather than bilateral trade shares in aggregating foreign prices and exchange rates across across countries.

Table 1

Chronology of Estimated Price Elasticities: Selected Studies for Industrial Countries

	Study/Source/Commodity	Estimator/ Price Behavior	Dynamic Structure/ Homogeneity	Price Data/ Frequency; Sample	Country	Price Elasticities Exports	Price Elasticities Imports
1.	Chang (1946, table IV) Total	OLS Exog.	Static Yes	Multilateral A; 1924-38	U.S.		-0.97
					U.K.		-0.28
					Japan		-0.47
					Germany		-0.37
2.	Krause (1962, table II) Non-oil	OLS Exog.	Static Yes	Cross-sec. A; 1947-58	U.S.		-1.98
3.	Kreinin (1967, table 3) Total	OLS Exog.	DL Yes	Multilateral A; 1954-64	U.S.		-1.11
4.	Heien (1968, pp 705-709) Total	OLS Exog.	DL Yes	Multilateral A; 1951-65	U.S.		-0.62
					Germany		-1.82
					Canada		-0.73
5.	Houthakker and Magee (1969, table 1) Total	OLS Exog.	Static Yes	Multilateral A; 1951-66	U.S.	-1.51	-0.54
					U.K.	-0.44	+0.22
					Japan	-0.80	-0.72
					Germany	+1.70	-0.24
					Canada	-0.59	-1.46
6.	Marston (1971, table 4) Total	OLS Exog.	Koyck Yes	Multilateral Q; 1955-67	U.K.		+0.27
7.	Magee (1972, p. 9) Non-oil	OLS Exog.	Static Yes	Bilateral A; 1951-69	U.S.	-3.75	-1.26
8.	Taplin (1973, table 2) Total	OLS Exog.	Static Yes	Multilateral A; 1953-70	U.S.		-1.05
					U.K.		-0.22
					Japan		-0.81
					Germany		-0.47
					Canada		-1.59
9.	Clark (1974, pp. 220-228)* Non-oil	OLS Exog.	PDL Yes	Multilateral Q; 1963-73	U.S.	-0.59	-3.72
10.	Miller and Fratianni Fratianni (1974, table 1) Total	OLS Exog.	Koyck Yes	Multilateral Q; 1956-72	U.S.	-1.30	-0.73
11.	Ahluwalia and Hernández-Catá (1975,table 1,p. 208) Non-oil	ILS Endo.	DL No	Multilateral Q; 1960-73	U.S.		-1.6
12.	Khan and Ross (1975, table 1) Total	OLS Exog.	Static Yes	Multilateral S; 1960-72	U.S.		-1.00
					U.K.		+0.40
					Japan		+0.15
					Germany		-0.53
					Canada		-2.13
13.	Hooper (1976, table 2) Non-oil	OLS Exog.	DL Yes	Multilateral Q; 1956-75	U.S.	-0.83	-0.54
14.	Murray and Ginman (1976, table 2), Total	OLS Exog.	Static No	Multilateral Q; 1961-68	U.S.		-1.05
15.	Khan and Ross (1977, table 2), Total	OLS Exog.	Koyck Yes	Multilateral Q; 1960-72	U.S.		-2.16
					Japan		-3.37
					Canada		-0.99

Table 1 (continued)

Study/Source/Commodity	Estimator/ Price Behavior	Dynamic Structure/ Homogeneity	Price Data/ Frequency; Sample	Country	Price Elasticities Exports	Imports
16. Yadav (1977, table 2) Total	OLS Exog.	Koyck Yes	Multilateral Q; 1956-73	Canada		-1.37
17. Deppler and Ripley (1978, tables 11-18)* Non-oil	OLS Exog.	DL Yes	Multilateral S; 1964-76	U.S.	-1.05	-1.45
				U.K.	-0.47	-0.30
				Japan	-1.66	-0.66
				Germany	-0.60	-0.67
				Canada	0	-0.75
18. Goldstein and Khan (1978, table 5) Total	FIML Endog.	Static Yes	Multilateral Q; 1955-70	U.S.	-2.32	
				Japan	+2.47	
				Germany	-0.83	
19. Hooper (1978, table 3) Non-oil	OLS Exog.	Static Yes	Multilateral Q; 1955-77	U.S.		-1.04
20. Lawrence (1978, table 6) Non-oil	OLS Exog.	DL Yes	Multilateral S; 1962-77	U.S.	-1.85	-1.52
21. Stern, Baum, and Green (1979,tables 2,4), Total	OLS Exog.	DL No	Multilateral Q; 1953-76	U.S.	-0.20	-2.18
22. Wilson and Takacs (1979, tables 1,3-6) Non-oil	OLS Exog.	Shill. No	Multilateral Q; 1957-71	U.S.	-3.31	-4.78
				U.K.	-0.37	+0.03
				Japan	-11.68	-1.25
				Germany	-1.87	-0.12
				Canada	-0.24	-2.75
23. Goldstein, Khan, and Officer (1980, table 3) Total	OLS Exog.	Static Yes	Multilateral A; 1950-73	U.S.		-0.68
				Germany		-0.30
				Canada		-0.82
24. Geraci and Prewo (1982, table 1) Total	OLS Exog.	Koyck Yes	Bilateral Q; 1958-74	U.S.		-1.23
				U.K.		-0.79
				Japan		-0.72
				Germany		-0.60
25. Haynes and Stone (1983, table 1), Total	OLS Exog.	Static No	Multilateral Q; 1955-79	U.S.	-0.77	-0.60
26. Ueda (1983, table 1) Total	IV Endo.	Koyck No	Multilateral S; 1966-80	Japan	-1.75	-1.40
27. Warner and Kreinin (1983, tables 2, 5) Non-oil	OLS Exog.	PDL(M) Static(X) No	Multilateral Q; 1970-80	U.S.	-0.55	-2.53
				U.K.	-0.86	-1.42
				Japan	-0.30	-0.72
				Germany	-4.98	-0.27
				Canada	-1.37	-1.00
28. Helkie and Hooper (1988, tables 2-4)*, Non-oil	OLS Exog.	PDL Yes	Multilateral Q; 1969-84	U.S.	-0.85	-1.15
29. Cline (1989, table 4A.3) Total	OLS Exog.	DL Yes	Multilateral Q; 1973-87	U.S.	-1.09	-1.36
				U.K.	-0.67	-1.04
				Japan	-0.90	-0.69
				Germany	-0.66	-0.48
				Canada	-1.01	-2.35

Table 1 (continued)

Study/Source/Commodity	Estimator/ Price Behavior	Dynamic Structure/ Homogeneity	Price Data/ Frequency; Sample	Country	Price Elasticities Exports	Imports
30. Deyak, Sawyer, and Sprinkle (1989, table 1) Total	OLS Exog.	Koyck Yes	Multilateral Q; 1958-83	U.S.		-0.29
31. Krugman (1989, tables 2-3) Non-oil	OLS Exog.	DL Yes	Multilateral A; 1971-86	U.S.	-1.42	-0.93
				U.K.	-0.54	+0.99
				Japan	-0.88	-0.42
				Germany	-0.55	-0.09
				Canada	+0.80	-1.45
32. Moffet (1989, tables 5-6) Total	OLS Exog.	PDL No	Multilateral Q; 1967-87	U.S.	-0.82	-0.69
33. Noland (1989, table 1) Total	Grid/OLS Exog.	GDL Yes	Multilateral Q; 1970-85	Japan	-0.41	-0.67
34. Lawrence (1990, tables 8, 10), Non-oil	OLS Exog.	PDL Yes	Multilateral S; 1976-90	U.S.	-1.04	-1.47
35. Marquez (1990, table 2) Total	OLS Exog.	RL Yes	Multilateral Q; 1973-85	U.S.	-0.99	-0.92
				U.K.	-0.44	-0.47
				Japan	-0.93	-0.93
				Germany	-0.66	-0.60
				Canada	-0.83	-1.02
36. Clarida (1991, p. 17) Non-oil	NLS Exog.	ECM/DL Yes	Multilateral Q; 1968-90	U.S.		-0.93
37. Blecker (1992, tables A-1, A-5) Non-oil	OLS Exog	PDL Yes	Multilateral Q; 1975-89	U.S.	-0.72	-0.97

Notes:

Commodity	*Total*: Measure of trade volume includes oil trade. *Non-oil*: Measure of trade volume excludes oil trade.
*	Authors' aggregation of individual elasticity estimates using trade shares.
Homogeneity	*Yes*: Estimating equation maintains homogeneity of degree zero in prices.
Estimation Method	*IV*: Instrumental Variables *ILS*: Indirect Least Squares *NLS*: Nonlinear Least Squares *NLP*: Nonlinear Programing *OLS*: Ordinary Least Squares
Dynamic Structure	*DL*: Distributed Lags *ECM*: Error-correction Model *GDL*: Gamma Distributed Lags *Koyck:* Lagged Dependent Variable *PDL*: Polynomial Distributed Lags *RL*: Rational Lags *Shiller*: Shiller Lags *Static*: No allowance of delays
Price Data	*Multilateral*: Price data do not differentiate trading partners *Bilateral:* Price data refer to specific trading partners
Data Frequencies	*A*: Annual; *Q*: Quarterly; *S*: Semi-annual.
Exchange Rate System	*Fixed:* Estimation sample period is predominantly pre-1973. *Float:* Estimation sample period is predominantly post-1973. *Both:* Estimation sample period is roughly centered around 1973

see if there is significant evidence of a shift in price elasticity estimates with the move to more flexible exchange rates following the end of the Bretton Woods era. Krugman (1989), for example, has hypothesized that the increased variability of exchange rates during the floating rate period has induced a "delinking" of trade from exchange rates which presumably would show up as reduced price elasticities.

Table 2 presents the summary statistics for the price elasticities across the studies, including the range of estimates and the means and standard deviations (across the studies reporting estimates). These data indicate wide ranges of estimates across countries. The mean estimates indicate that the Marshall-Lerner condition is easily met for all three countries. The mean elasticity estimate for Japanese exports is substantially higher than the other elasticity estimates reported. This mean estimate is strongly influenced by the inclusion of an outlier associated with the study of Wilson and Takacs. Excluding their estimate from the computations yields a mean price elasticity for Japanese exports of -0.96, which is more in line with an average of estimates from five studies completed in the past decade.[21]

The substantial dispersion of elasticity estimates is troublesome, but undoubtedly reflects differences across studies in the types of characteristics listed in Table 1 (as well as other differences that we have

21. One of the recent studies, Cline (1989), reports an aggregate own price elasticity for Japanese exports of about -0.9. With the inclusion of cross-price elasticities, Cline's estimate for Japanese exports rises to -1.3. As noted above, however, the cross-price elasticity estimate Cline reports is heavily constrained. In another study, not included in table 1, Hickok (1989) estimates that the price elasticity for Japanese exports is -1.1 based on an average of elasticity estimates reported by Corker (1989). On the same basis, Hickok estimates that the price elasticity of Japanese imports is only -0.4.

Table 2

Summary Statistics on Estimates of Price Elasticities

Variable	Mean	Std. Dev.	Minimum	Maximum	Number of Studies
United States					
Exports	-1.31	0.92	-3.75	-0.20	19
Imports	-1.35	0.93	-4.78	-0.29	32
Japan					
Exports	-1.68	3.70	-11.70	2.47	10
Imports	-0.97	0.78	-3.40	-0.26	13
Germany					
Exports	-1.06	1.87	-5.00	1.70	8
Imports	-0.50	0.44	-1.82	-0.09	13

Source: Data in table 1.

not tried to correct for). In a crude attempt to quantify the relative importance of the contribution of these characteristics to the dispersion of elasticity estimates, we estimate the following "fixed-effect" equation:

$$(27) \qquad \epsilon_i = \phi_0 + \phi_1\text{PRE-FLOAT} + \phi_2\text{SIMULT.} + \phi_3\ \text{NON-HOMOG} + \phi_4\text{ANNUAL} + \phi_5\text{NO-LAGS} + \phi_6\text{SHILLER} + \phi_7\text{COMMODITY} + u_i,$$

where ϵ_i = long-run elasticity estimate reported by the ith study.

PRE-FLOAT = dummy variable equal to one if the estimation period corresponds to fixed exchange rates; zero otherwise.

SIMULT. = dummy variable equal to one if the model was estimated with simultaneous equation estimation techniques; zero otherwise.

NON-HOMOG = dummy variable equal to one if price homogeneity is not maintained; zero otherwise.

ANNUAL = dummy variable equal to one for annual data; zero otherwise.

NO-LAGS = dummy variable equal to one if delayed responses are absent; zero otherwise.

SHILLER = dummy variable equal to one if Shiller lags are used; zero otherwise.

COMMODITY = dummy variable equal to one if oil is included in the measure of trade; zero otherwise.

$u_i \sim N(0, \sigma^2)$.

The parameter ϕ_0 in equation (27) is the mean of the elasticity estimates of the prototypical in our survey, which uses (1) data for the period of floating exchange rates, (2) is estimated with OLS, (3) assumes price homogeneity, (4) use either semi-annual or quarterly data, (5) allows for lagged responses, (6) does not use a Shiller lag, and (7) excludes oil from the measure of trade volume. The other parameters in the equation measure the extent to which the alternative characteristics change the mean elasticity. For example, finding that $\hat{\phi}_1$ is significantly different from zero means that elasticity estimates shifted between the fixed and floating rate periods.[22]

To estimate the parameters of (27), we use weighted least squares where the weights are the estimated standard errors.[23] The estimation results, shown in Table 3, indicate that the estimated price elasticity of the prototypical study is close to -1.0 for both U.S. exports and U.S. imports. The results also suggest that the alternative methodological characteristics can explain a good deal of the variation in elasticity estimates across studies. Estimates for studies focusing on data during the pre-floating rate period, yielded significantly higher elasticity estimates (in absolute terms) for U.S. imports, tending to support Krugman's "delinking" hypothesis. Export elasticities tended to be somewhat higher in the earlier studies as well, but this difference was not statistically significant. Studies that did not assume homogeneity in prices tended to show an (insignificant) tendency to lower the estimated price elasticity of exports and a (significant) tendency

22. We stress that this equation is no more than a vehicle to aid in our accounting for the implications of alternative study designs. We also recognize that effects attributed to a particular characteristic could reflect the influence of other aspects of a study's design (such as differences in data and disaggregation) that we have not captured in the set of characteristics we have singled out.

23. A few studies do not report estimates of the standard errors. If the study indicates, however, that the elasticities are significant, then we impute t-statistic of 2. If the study does not give a sense of how significant are the price elasticities, then we input a t-statistic of one.

Table 3

Fixed-Effects Model for Long-run U.S. Price Elasticities
(t-statistics in parentheses)

	EXPORTS	N	IMPORTS	N
Intercept	-0.93 (-2.9)		-1.23 (-4.4)	
Pre-float	-0.30 (-0.7)	10	-0.96 (-3.0)	21
No-Homogeneity	0.86 (1.2)	5	-0.74 (-2.4)	8
Annual Data	-1.40 (-1.7)	4	0.04 (0.1)	9
No lags	-0.84 (-1.1)	5	0.70 (2.2)	10
Shiller Lags	-2.92 (-3.7)	1	-1.86 (-4.2)	1
Simultaneity	1.15 (1.5)	1	0.58 (0.7)	1
Commodity			0.70 (2.9)	18
$\bar{R}^2$	0.81		0.88	
Significance	0.00		0.00	
Sample Mean	-1.31		-1.35	
Sample Size	19		32	

The data source is table 1. The letter N stands for the number of studies with the associated characteristic.

to raise the price elasticities for imports. The use of annual data tended to show larger elasticities for exports but not for imports.[24] The choice of estimation technique (OLS versus simultaneous) did not significantly affect the elasticity estimates.[25] The inclusion of oil in the measure of trade dampens significantly the value of the estimated price elasticity. Finally, the absence of lags yielded smaller elasticities for imports, and the use of Shiller lags appeared to yield substantially larger estimates for both imports and exports.[26] On the export side, the small number of studies that did not use lags found larger elasticities on average, but this effect was not statistically significant.

Empirical analysis of exchange rate pass-through. The picture that emerges from a variety of empirical analyses of pass-through is that U.S. exporters, on average, tend to pass through most (80 to 100 percent) of an exchange rate change into their foreign export prices, whereas Japanese and European exporters pass through considerably less -- 50 to 70 percent. The

24. In the absence of homogeneity, the price elasticity was based on the estimated coefficient on the foreign-price, whether or not it was combined with an exchange-rate term.

25. Only two studies reported results based on simultaneous estimation techniques, (Goldstein and Kahn (1978) for export elasticities and Ahluwalia and Hernandez-Cata (1975) for import elasticities). Both studies reported price elasticities that were slightly above average. Several other studies that reported OLS results noted that in preliminary testing, simultaneous-equation estimation yielded very nearly the same results as OLS estimation--see, for example, Geraci and Prewo (1982), Helkie and Hooper (1988), and Ericsson and Marquez (1993).

26. The Shiller lag was singled out despite the fact that only one study (Wilson and Takacs (1979)) used this technique, because many of the elasticities reported in that study were outliers. The extremely high elasticity estimates reported in Wilson and Takacs (1979) study may well have been due to characteristics of that study other than the use of Shiller lags, however.

lower pass-through for Japan and Europe is consistent with the range of estimates for pass-through to aggregate U.S. import prices (again 50 to 70 percent). Hooper and Mann (1989), Moffet (1989), and Lawrence (1990), each use a variant of the markup model (equation (17) above) and find results consistent with these ranges for aggregate U.S. export and or import prices.[27]

Other empirical studies have been more micro-oriented, focusing on pass-through at the industry level. Gagnon and Knetter (1992) for autos, and Knetter (1993) and Ohno (1989) for a wide variety of industries find very little or no evidence of pricing to market behavior by U.S. exporters. Branson and Marston (1989), Feenstra (1989), Gagnon and Knetter (1993), Marston (1990), and Ohno (1989) all find significant evidence of pricing to market (or absorption of exchange rate changes) by Japanese exporters in a variety of industries. In most cases, the analyses focuses on the behavior of Japanese export prices to all regions relative to domestic Japanese prices or costs. Hooper and Mann (1989) and Knetter (1993) consider some regional disaggregation and find no evidence to suggest that Japanese exporters behave differently with respect to alternative foreign markets. Knetter (1993) finds that German and U.K. exporters, on average, behave similarly to Japanese exporters. However, Gagnon and Knetter find that evidence of pricing to market for autos is much weaker for German exporters than for Japanese exporters autos.

27. Using Hooper and Mann's model and data set, Swamy and Thurman (1993) have estimated a pass-through equation for U.S. imports with a variable-coefficient technique. They find that pass-through has varied between 56 percent and 67 percent over the period 1967-88, and that it was in the middle of that range during the latter part of the period.

In a survey-based analysis of the pricing behavior of U.S.-owned multinational corporations, Rangan and Lawrence (1993) offer two explanations for the asymmetry between estimates of nearly full pass-through on the part of U.S. exporters and incomplete pass-through of foreign exporters to the United States. One is that these U.S.-owned firms tend to price to the market in which they sell globally, and that in the case of U.S. exports, is reflected in fluctuations in the profits of their foreign offices, not on the books of their home offices in the United States. A second explanation concerns the measurement error. Rangan and Lawrence contend that U.S. firms, for various reasons, often provide the same response to BLS surveys of domestic and export prices.

Empirical tests of the importance of raw material prices in reducing pass-through have been limited largely to the behavior of Japanese export prices. In tests for a number of individual Japanese export industries, Marston (1990) and Ohno (1989) do not find significant empirical evidence that the sensitivity of raw material prices to exchange rates influences pass-through. However in tests at a more aggregative level, Hooper and Mann (1989) find evidence that such effects are significant for overall Japanese manufactured exports.

With respect to the presence or absence of hysteresis, Baldwin finds some evidence of a shift in the behavior of U.S. import prices in the wake of the large swing in the dollar during the 1980s. However, Hooper and Mann (1989), Melick (1990), Ohno (1989), and Knetter (1991) failed to find significant evidence of such shifts.

Cointegration. An issue that is gaining attention in the literature is the estimation of price elasticities in the context of co-integrated systems. Clarida (1991) estimates a model for U.S. imports of consumer goods in a framework that allows for cointegration--that is, ensuring that U.S. imports and its determinants have move together in the long run. Clarida finds that the cointegrating relationship between imports and income and relative prices yields income and price elasticities that are very similar to those of Cline (1989) and Helkie and Hooper (1988), studies that did not use cointegration analysis.[28] Melick (1990) does much the same for the pass-through relationship, and finds cointegrating relationships for U.S. import prices that are consistent with the pass-through coefficients reported by Hooper and Mann (1989) for U.S. import prices.

IV. Exchange Rates and External Adjustment Since 1980.

This section presents an empirical analysis of the extent to which movements in exchange rates have contributed to external adjustment in the United States and Japan since the early 1980s. We begin with a review of the data on nominal and real exchange rates and external balances. We then then estimate trade equations and use them to simulate the influence of movements in exchange rates.

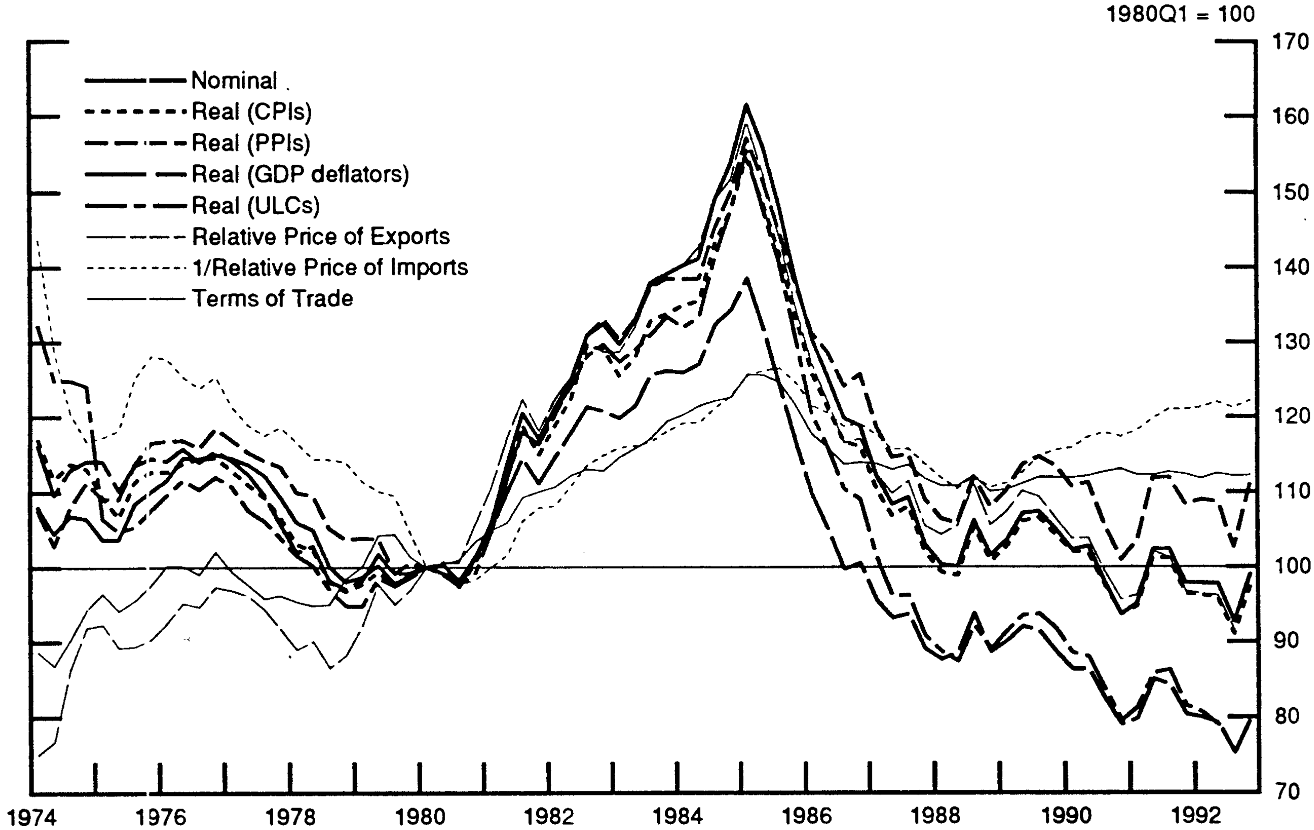
Exchange Rates, Prices, and External Balances: The U.S. Experience. Movements in a variety of alternative measures of the foreign exchange value of the dollar against an average of the currencies of major U.S. trading partners over the past two decades are shown in Chart 1. The currencies included are those of the foreign G-7 industrial countries plus Korea, Mexico,

28. We also applied Johansen's cointegration tests to data on per-capita non-oil imports, per-capita GDP, and relative prices. Based on quarterly data for 1949:2-1993:1, we found a unique cointegration vector among these variables.

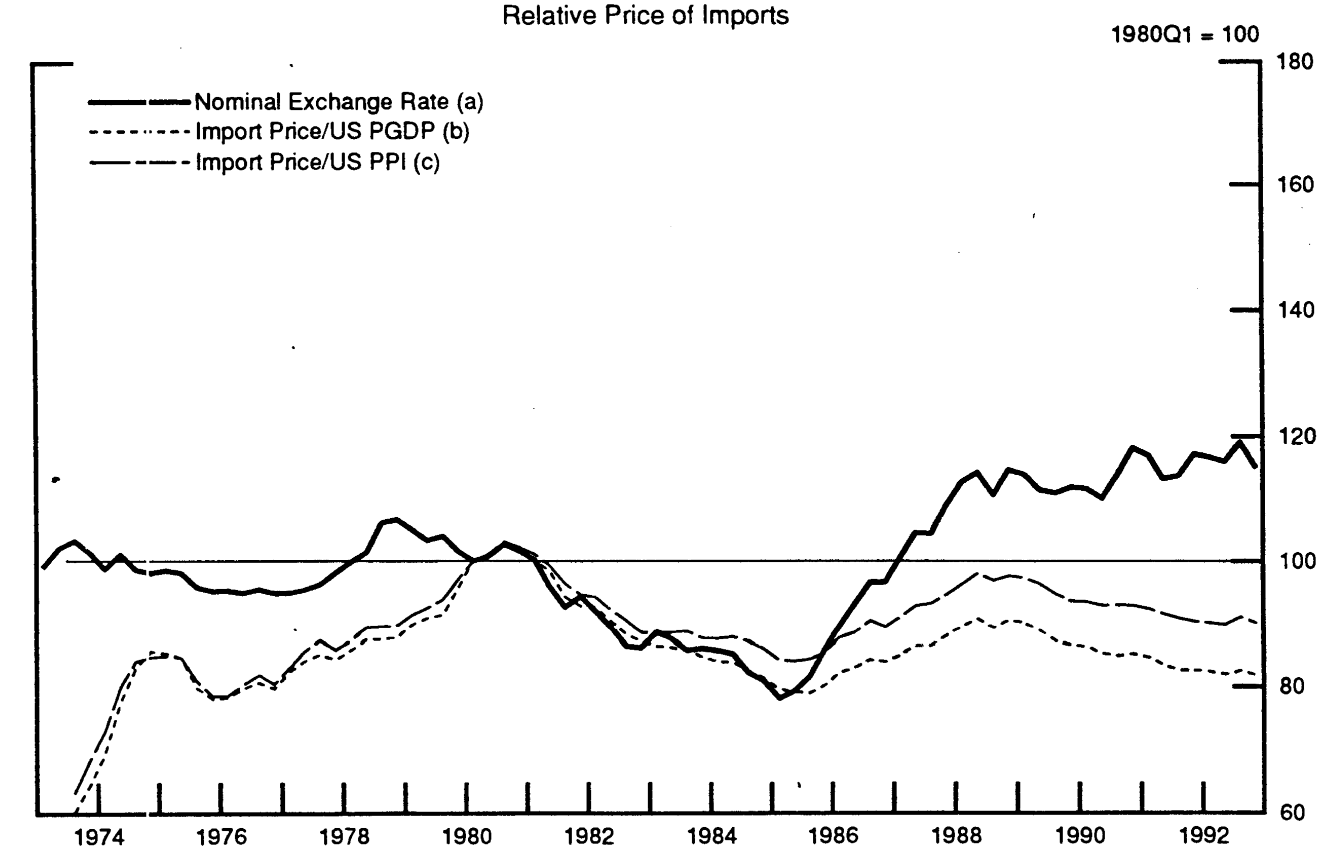
Chart 1

Dollar Exchange Rates : Weighted Averages of Nine Currencies

(Foreign Currency/$)



Relative Price of Imports



(a) Using bilateral US import weights, $/foreign currency; excludes Mexico
(b) Prices of non oil imports excl. computers divided by US GDP deflator
(c) Prices of non oil imports excl. computers divided by US PPI manufacturing

and Taiwan.[29] The indexes are weighted by each country's relative share in world trade and they are expressed in terms of units of foreign currency per dollar. The method of constructing these indexes and more details on the underlying data and weights are discussed in Appendices A and B. Changes since 1980 are of particular interest to the analysis presented later in this section.

In nominal terms, the dollar appreciated over 60 percent on this basis between 1980 and early 1985; that appreciation was then fully reversed by late 1987, and the dollar has fluctuated in a much narrower range around its 1980 level since 1987. The chart also shows several different measures of the dollar's real exchange rate: the ratios of U.S. to foreign CPIs, GDP deflators, and producer prices and unit labor costs in manufacturing, all in dollars. It also shows the relative price of exports, the inverse of the relative price of imports and the terms of trade. The relative price of exports is the ratio of the price of U.S. exports excluding agricultural goods and computers to a weighted average of foreign GDP deflators in dollars; the relative price of imports is described below. That measure shows essentially the same picture as the dollar's nominal exchange rate, indicating that nominal exchange rate changes were largely passed through to U.S. export prices denominated in foreign currencies (i.e., dollar export prices did not move much in response to exchange rate changes). The ratio of CPIs follows much the same pattern as the nominal rate as well. However, the terms of trade, the relative price of imports and relative PPIs have not returned to their 1980 levels, while on the basis of relative GDP deflators and unit labor

29. In 1992, these nine countries accounted for two-thirds of U.S. exports plus non-oil imports.

costs the dollar's real exchange rate has fallen significantly below its 1980 level.

We suspect that a good deal of the net decline in the relative GDP deflator and unit labor cost measures since 1980 reflects differences in the treatment of computer prices across countries. Rapidly declining computer prices in the United States caused both the GDP deflator to rise more slowly than their counterparts abroad where different measures of computer prices are employed. The same difference caused U.S. manufacturing output (hence manufacturing productivity) to rise more rapidly, which means U.S. manufacturing unit labor costs rose more slowly than those abroad.

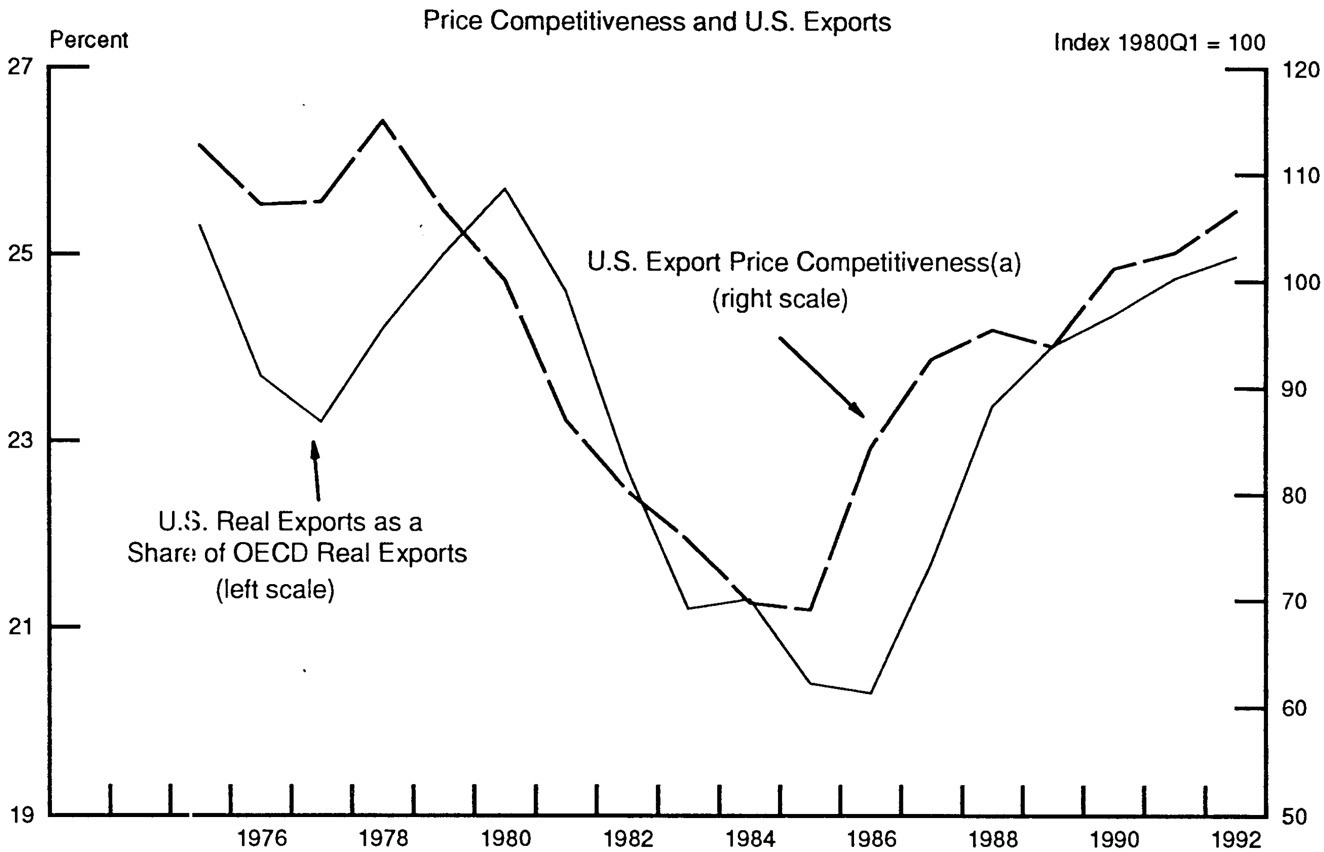
The bottom panel shows a different measure of the dollar's nominal exchange rate and two measures of the relative price of U.S. imports: (1) the ratio of the price of imports excluding oil and computers to the U.S. GDP deflator (the inverse of which is shown in the top panel, and (2) the ratio of the same import price to the U.S. PPI for manufactured goods. In this case, the exchange rate is expressed in terms of dollars per unit of foreign currency, weighted by shares in U.S. imports for the same set of countries as in the top panel. On this basis, the dollar appreciated much less (than on a world-trade-share-weighted basis) during the early 1980s and has more than reversed that appreciation since the mid-1980s. Unlike the relative price of exports the relative price of imports (using the GDP deflator as the denominator) has deviated significantly from the nominal exchange rate in recent years. While this measure of the relative price fell about in line with the exchange rate when the dollar appreciated, it rose much less when the dollar depreciated, indicating that the depreciation was not being fully passed through. When the nominal exchange rate moved above its 1980 level during the latter 1980s, the relative price of imports remained well below its 1980 level, suggesting the possibility of some asymmetry in the pass-through response over the period. The relative price of imports measured using the U.S. PPI for manufactured goods as the denominator has risen somewhat more in recent years. Nevertheless, the gap between that relative price and the nominal exchange rate remains sizable.

The effect of the swing in the relative price of exports on U.S. export performance over the past decade is illustrated vividly in the top panel of Chart 2. The dashed line is a measure of U.S. export price competitiveness: the reciprocal of the relative price of exports shown in Chart 1. The solid line is the share of U.S. real exports in the real exports of all OECD countries. Movements in the U.S. market share followed movements in the price ratio quite closely, with a lag of about one year. The export share dropped sharply during the first half of the 1980s, but had returned to about its 1980 peak by the end of the decade.[30]

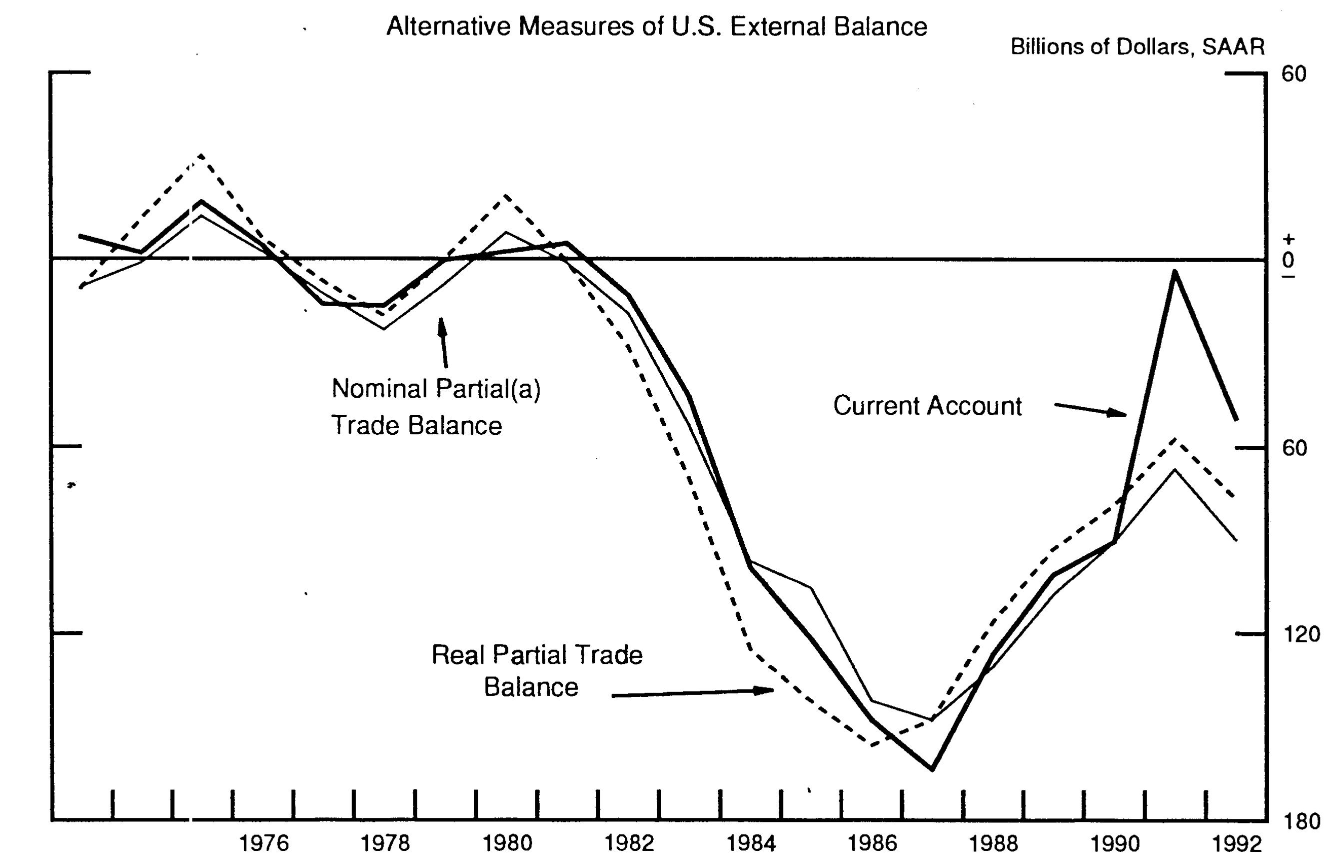
The bottom panel of Chart 2 shows movements in various measures of the U.S. external balance, including the current account, the nominal partial trade balance, and the real partial trade balance. (The partial trade balances are calculated as net exports of goods excluding oil imports, agricultural exports, and imports and exports of computers; the real balance is measured in billions of 1987 dollars.) Most of the swings in the current

30. We also analyzed the increase in the U.S. share of OECD exports between 1986 and 1991 to determine the extent to which that increase reflected relatively rapid growth in the markets the United States exports to (as opposed to an increase in U.S. competitiveness). We found that the growth of imports of OECD countries weighted by each country's share in U.S. exports was essentially the same as the growth of total OECD imports. This result indicates that the increase in U.S. market share was attributable primarily to an increase in U.S. competitiveness.

Chart 2



(a)Inverse of relative price of exports shown in Chart 1.



(a)Nonagricultural excl. computers minus non–oil imports excl. computers account, from surplus in 1980 to unprecedented deficit in the mid-1980s, to near zero in 1991 and back into deficit more recently--can be accounted for by swings in the real partial trade balance. The correlation between the two series was remarkably close over this period, with two notable exceptions. One exception was during 1987, when the nominal deficit persisted longer than the real deficit because the initial effect of the depreciation of the dollar during that period was to raise the price of imports and therefore to push up nominal imports while depressing real imports. The other notable exception was during 1991, when one-time cash grants associated with foreign financing of the Persian Gulf war boosted the U.S. current account $43 billion.

In the econometric analysis that follows, we focus on the U.S. partial trade balance, partly because it explains most of the movement in the overall current account, and partly because the excluded trade categories do not conform to the conventional trade model based on the assumption of imperfect substitutability. Both oil and agricultural commodities can reasonably be viewed as goods that are perfect substitutes across countries. With respect to computers, as Meade (1991) and Lawrence (1990) have shown, computers present a different problem to empirical analysis of U.S. trade because their prices (as measured by BEA's hedonic index) behave so radically differently from those of other goods.[31] (A problem also arises with respect to international comparability because most other industrial countries have yet to apply hedonic techniques in the measurement of computer prices.)

31. Measured in real terms both imports and exports of computers have grown extremely rapidly over the past decade, but their net effect on the U.S. trade <u>balance</u> has been quite small.

The Japanese Experience. Various measures of the yen's weighted average exchange rate are shown in the top panel of Chart 3. Movements in the alternative indexes for the yen have deviated even more widely since the early 1980s than those for the dollar. The yen has appreciated substantially less in real terms than in nominal terms, reflecting Japan's relatively low rates of CPI and manufacturing PPI inflation over this period. On a PPI-adjusted basis, the real yen appreciated about 30 percent on balance between early 1980 and mid-1992. Despite the significant appreciation of the yen in both nominal terms and real terms, however, Japanese export prices actually declined relative to foreign GDP deflators in yen by 10 percent on balance over the same period. The relative price of exports did rise as much as 10 percent during the latter 1980s with the sharp appreciation of the yen during that period, but that increase has been more than reversed since 1989. The reasons for this striking deviation between exchange rates and relative prices relate to the strong effects of exchange rates on Japanese import prices and production costs and to the pass-through behavior of Japanese exporters, among other factors, as we consider in more detail later in this section.

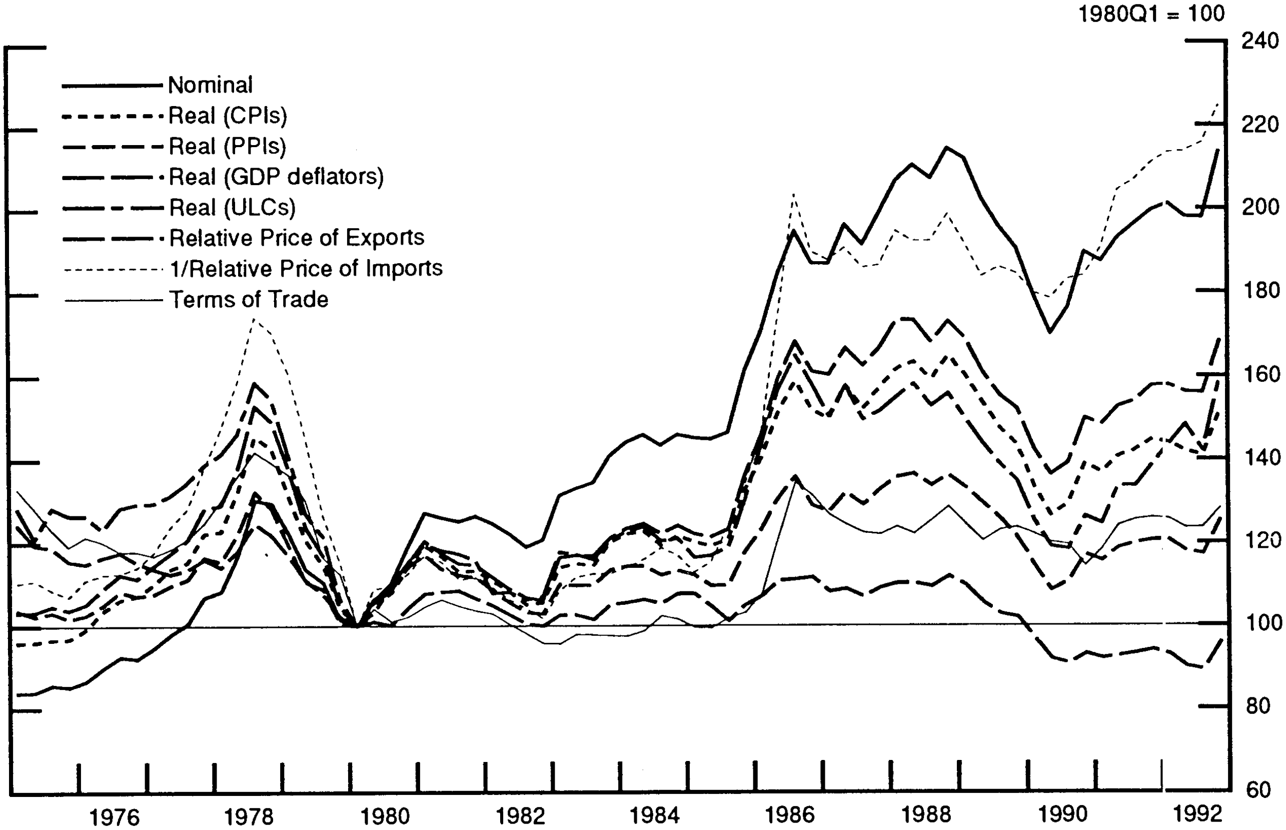
Unlike the relative price of exports, the relative price of Japanese imports has moved very closely in line with the nominal yen exchange rate since 1980, as indicated in both the top and the bottom panels of Chart 3.[32] This close correlation suggests that a high percentage of movements in the yen is passed through into Japanese import prices.

32. The exchange rate index in the bottom panel again differs from that in the top panel because it is inverted and is based on Japanese import weights instead of multilateral trade weights. These weights are given in Appendix A.

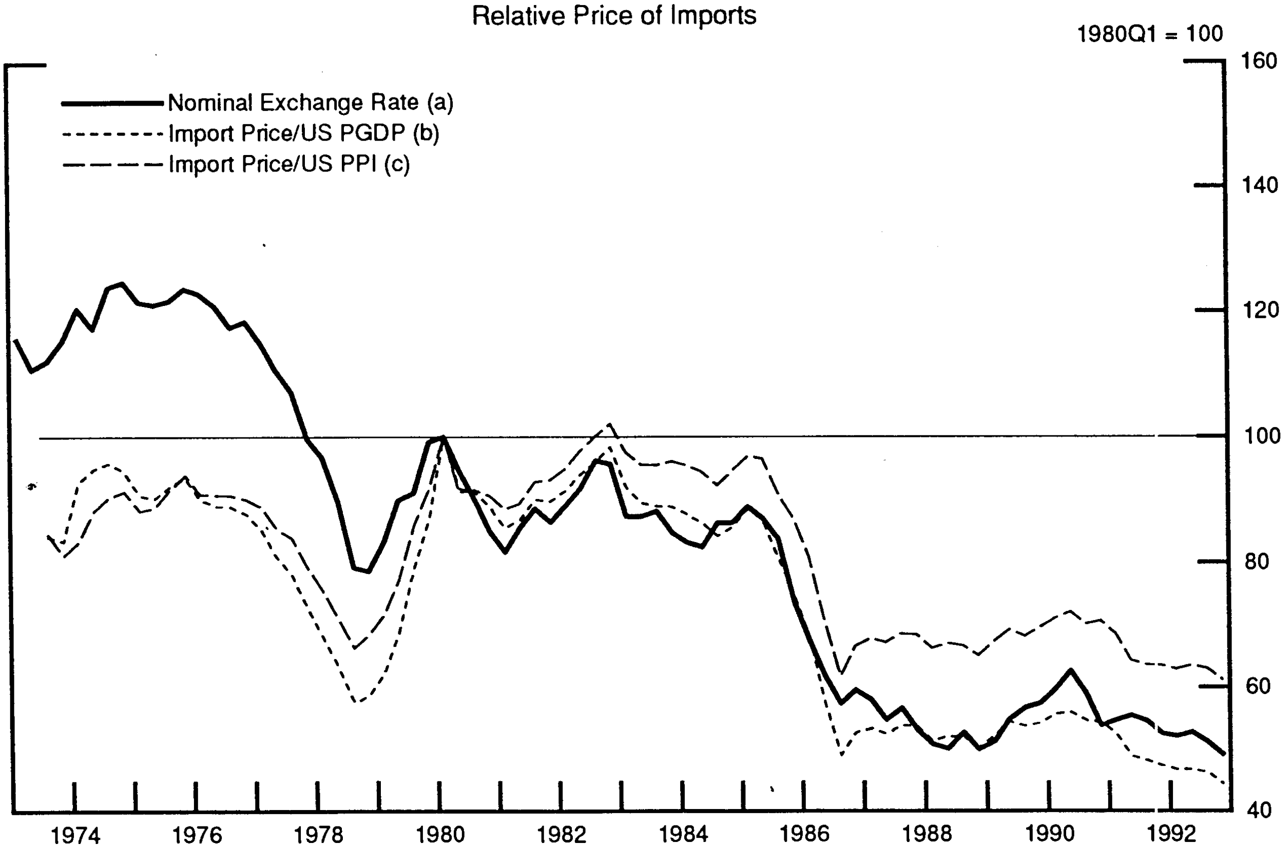
Chart 3

Yen Exchange Rates : Weighted Averages of Nine Currencies

(foreign currency / yen)



Relative Price of Imports



(a) Using bilateral Japanese import weights, Yen/foreign currency
(b) Prices of non oil imports divided by Japanese GDP deflator
(c) Prices of non oil imports divided by Japanese PPI manufacturing

The relationship between export price competitiveness and export shares, shown in the top panel of Chart 4, is not as tight for Japan as for the United States. As indicated in the bottom panel, Japan's real partial trade balance has account for much but not all of the variation in the current account since 1980.

Estimated Trade Equations. We now turn to the estimation of a version of the conventional model of trade volumes and prices presented in Section II for the United States and Japan. The volume (structural demand) equations we estimate for imports and exports are essentially the same as equations (8) and (9) in Section II, which we have modified to incorporate distributed lags:

(8′) $Q_m = f[y, p_t, p_{t-1}, \ldots, p_{t-n}],$

(9′) $Q_x = f^*[(y^*, p^*_t, p^*_{t-1}, \ldots, p^*_{t-m}],$

where $p_t = P_{mt}/P_t$, $p^*_t = P_x/(P^*/S)$.

The price (supply) equations are based on the reduced-form import price equation (24) in Section II:

(24′) $P_{mt} = g[(W^*/S)_t, \ldots, (W^*/S)_{t-n}, (P^*_r/S)_t, \ldots, (P^*_r/S)_t, y, P_t, \ldots, P_{t-n}].$

The export price equation is treated symmetrically:

(23′) $P_{xt} = g^*[W_t, \ldots, W_{t-p}, P_{rt}, \ldots, P_{r,t-m}, y^*, (P^*/S)_t, \ldots, (P^*/S)_{t-k}],$

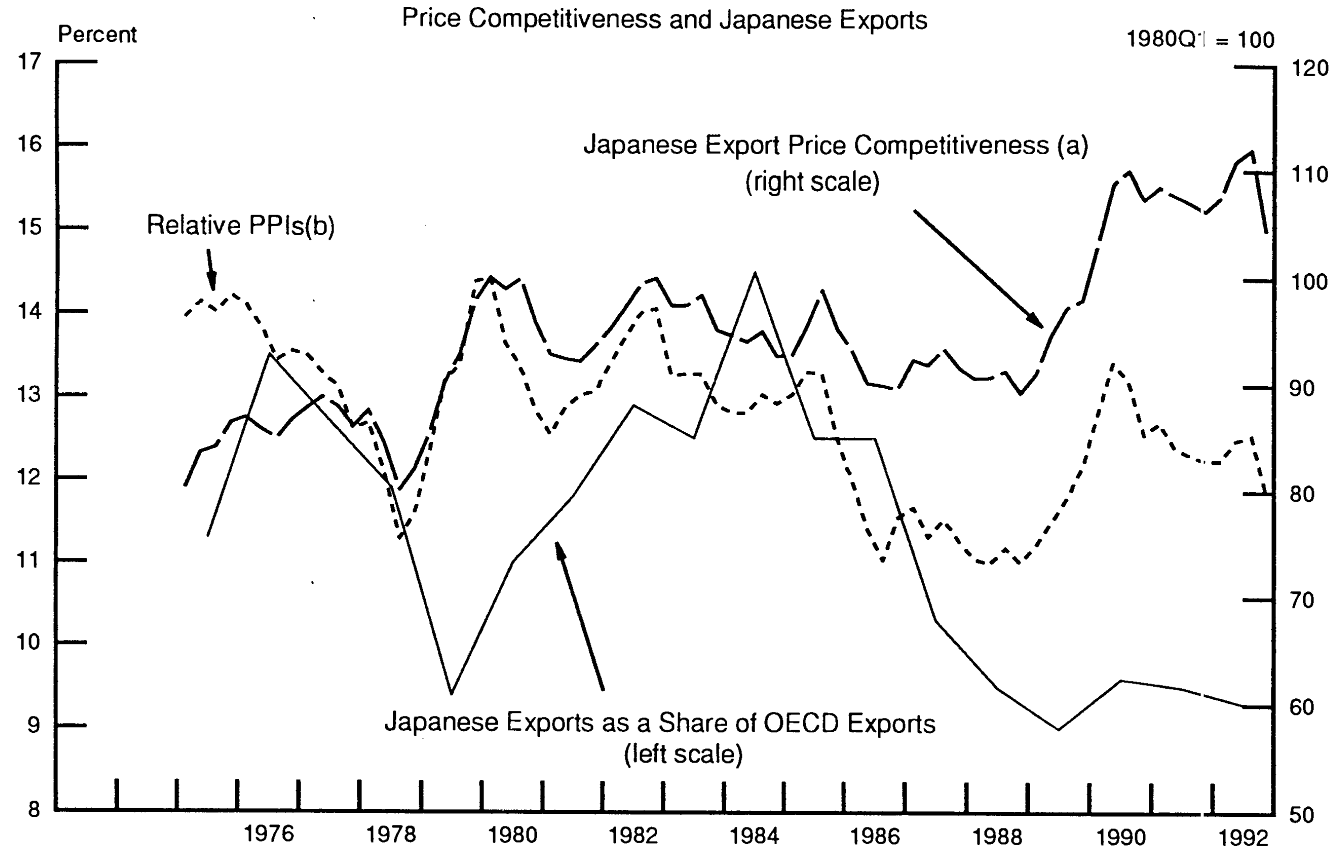
where the variables are defined:

P = GDP deflator or manufacturing PPI

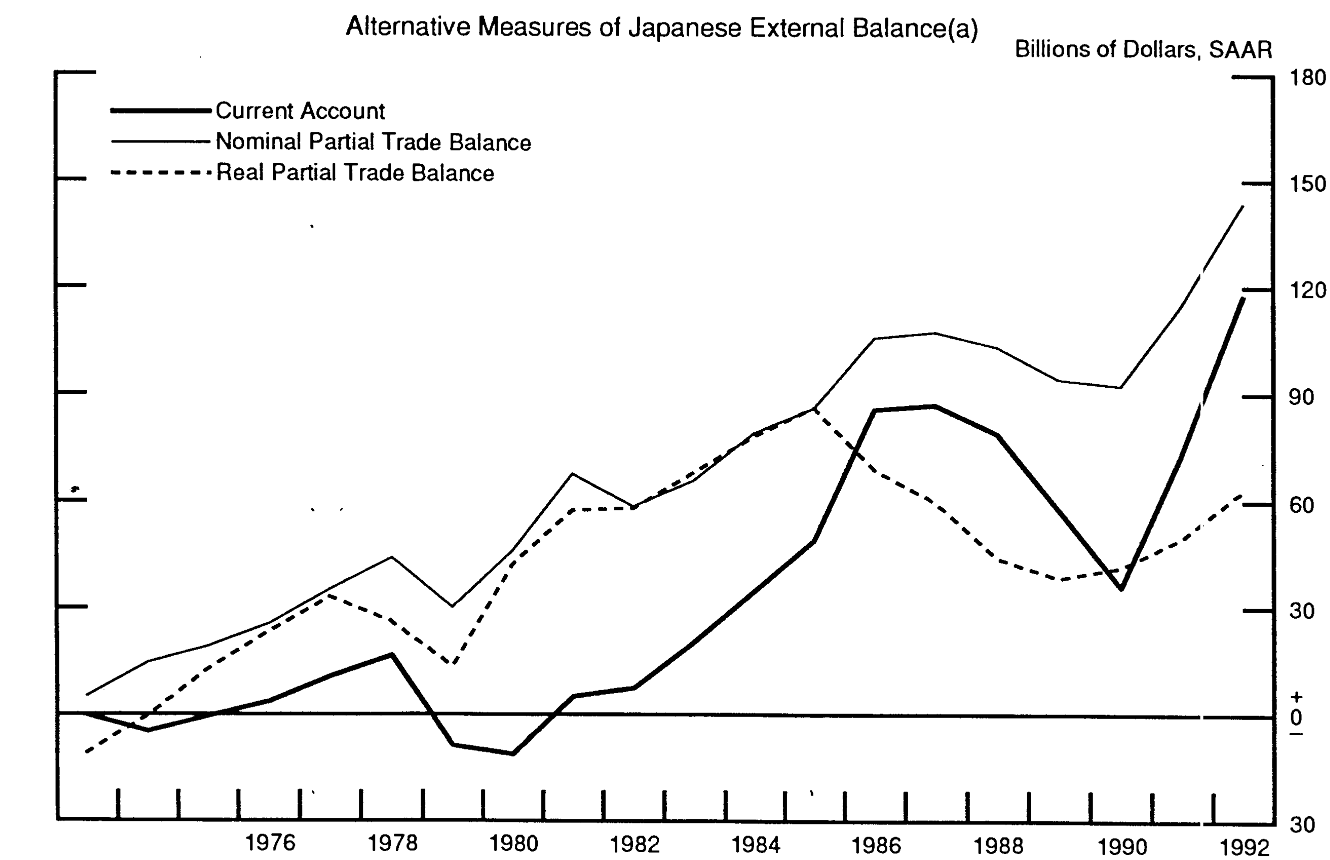
P_m = Non-oil import price index, denominated in the importer's currency

P_x = Export price index, denominated in the exporter's currency

Chart 4



(a)Inverse of relative price of exports as defined in Chart 3
(b)Foreign manufacturing PPIs in yen over Japanese PPI



(a)Exports minus non–oil imports

P_r = World commodity price index, denominated in exporting country's currency

Q_m = Non-oil import volume

Q_x = Export volume

S = weighted average exchange rate (foreign currency/home currency)

W = Unit labor cost in manufacturing

y = Real GDP

Foreign variables, denoted by "*", and the exchange rate are weighted averages across the 10 countries included in our sample (not including the home country).[33] The data we employ, some of which were presented in the preceding subsections, are described in detail in Appendix B.[34] The two components of cost, W and P_r did not always perform well in unrestricted estimation, possibly because of significant collinearity among the various price and cost variables. In the results below for the United States, we report estimates for a single coefficient on the following weighted sum of the unit costs: $\log C = .75 \log W + .25 \log P_r$.

The equations were estimated in double-log functional form, so that the coefficient estimates are elasticities. Fair's two-stage least squares method for simultaneous estimation was employed (treating prices as endogenous variables in the demand equation) with Cochrane-Orcutt correction for serially correlated residuals. Lags in the response to price and cost changes were incorporated either with a combination of unrestricted lags and a lagged

33. P^*/S, for example is the foreign price measured in terms of the currency of the country whose import (or export) price is being determined.
34. Recall that the U.S. equations exclude computers from import and export prices and quantities.

dependent variable or with Almon distributed lags. These two lagging methods yielded very similar results for long-run relative price and pass-through elasticities, and we have reported the results for Almon lags. The lags on relative prices in the quantity equations are eight quarters in length, and those on the determinants of prices in the price equations are 4 quarters long. Other lag lengths were tested, but generally yielded about the same long-run elasticity estimates. The estimation sample period started somewhere between 1972 and 1976 and ended in mid-1992, using quarterly data.[35]

U.S. Estimation Results. The results for the U.S. quantity and price equations are presented in Table 4, which reports long-run elasticity estimates. All of the estimated elasticities have the expected sign and are statistically significant. The long-run price elasticities in the volume equations are both about -1.0, very close to the mean estimates we found in our survey of the literature for models of this type.[36] The income elasticities in the volume equations are consistent with the Houthakker-Magee asymmetry (i.e., the import elasticity is well in excess of the export elasticity).[37]

35. The sample period varied from equation to equation depending upon the availability of data for the variables in each equation. The results were not altered appreciably when a common sample period (1976:Q2-1992:Q2) was imposed across all equations.

36. Relative prices enter in the volume equations with a second-order Almon polynomial over eight quarters.

37. Also, in general here and in the results for Japan in Table 5 (except as noted), the estimation results do not reject the assumptions embodied in estimation for the trade volume and price equations. That is, the residuals satisfy the assumptions of normality, serial independence, and homoskedasticity. The exceptions are normality in the U.S. price equations, serial independence in the Japanese export-volume equation, and heteroskedasticity in the Japanese export-price equation.

Table 4

Long-run Coefficient Estimates for U.S. Trade
(t-statistics in parentheses)

Trade Volumes

	EXPORTS	IMPORTS
Income	1.00	2.50
	(14.1)	(7.5)
Relative Prices	-1.01	-1.03
	(-8.4)	(-3.7)
Rho	0.75	0.81
$\bar{R}^2$	0.986	0.989
Jarque-Bera	0.38	0.61
Serial Independence	0.03	0.89
ARCH	0.48	0.76
Sample	1972:2-1992:2	1976:3-1992:2

Trade Prices

	EXPORTS	IMPORTS
U.S. Costs	0.77	
	(5.9)	
Foreign Prices in $	0.16	
	(2.7)	
U.S. Domestic Prices		0.51
		(3.2)
Foreign Costs in $		0.55
		(7.8)
$\bar{R}^2$	0.45	0.71
Jarque-Bera	0.97	0.96
Serial Independence	0.33	0.03
ARCH	2.70	0.48
Sample	1975:1-1992:3	1975:1-1992:2

Notes: Relative prices enter in the volume equations with a second-order Almon lag over eight quarters Almong lag.

The results for the price equations indicate that U.S. export prices are quite sensitive to U.S. costs (with an elasticity of 0.77) but not very sensitive to foreign prices in dollars (with an elasticity of 0.16).[38] The coefficient on the foreign price term implies that a one-percent appreciation of the dollar lowers dollar-denominated export prices by 0.16 percent and raises the foreign-currency value of these prices (the price paid by foreign importers) by 0.84 percent. That is, the pass-through coefficient for foreign import prices (φ) is approximately -0.84.[39] The results for U.S. import prices indicate that a one-percent increase in foreign costs raises these prices by 0.55 percent whereas a one percent appreciation of the dollar lowers these prices by 0.55 percent (pass-through of -0.55).[40] Thus, unlike the case of export prices, equal increases in foreign costs and the value of the dollar

38. These variables enter in the export-price equation with a second-order Almon polynomial over four quarters. The results reported for the price equations do not include coefficients for real income in the importing country. Those coefficients were found to be uniformly statistically insignificant and and the income variables were dropped from the price equations.

39. Recall from equation (20) that the pass-through coefficient for import prices (in this case "foreign" import prices) is equal to the elasticity of the export price with respect to the exchange rate minus 1.0. The estimated coefficient on the foreign price term in dollars is only an approximation of the elasticity of U.S. export prices with respect to the exchange rate; that coefficient also reflects the effects of independent movements in foreign prices in foreign currency. The approximation is a fairly close one, however, because movements in the exchange rate account for most of the variance in the foreign prices in dollars: the correlation between the foreign price term and the exchange rate over the sample period is 0.68. Pass-through could be somewhat less than 84 percent because we have not factored in the possible effects of exchange rate changes on the prices of raw materials in the United States.

40. As in the case of export-prices, these variables enter in the export-price equation with a second-order Almon polynomial over four quarters.

have similar effects on U.S. import prices. These estimates are fully consistent with those of other studies surveyed in the preceding section.[41]

Japanese Estimation Results. Results for Japanese export and import volume and price equations are shown in Table 5. The estimated price elasticities for Japanese exports and imports (-0.8 and -0.7, respectively) are significantly less than those for the United States. These estimates are roughly consistent with averages of the most recent five studies (included in Table 1 in the preceding section) reporting estimates for Japan (-0.7 and -0.7, respectively).[42]

In the Japanese import price equation, when the Japanese PPI was included as a competitive price term, it dominated the equation and the coefficient on foreign costs became insignificant. Given the composition of Japanese imports (many of which are not produced domestically), this result seemed implausible, and may well have reflected either multicollinearity or some degree of reverse causation. For this reason we estimated the import price equation without Japanese competitive prices included. We also left the components of unit costs in the Japanese price equations unconstrained. In the case of the export price equation, the coefficients on unit labor costs and raw material prices (0.6 and 0.3 respectively) are consistent with the

41. However, the results for the export price equation are less robust than we might have hoped, inasmuch as the residuals of that equation do not conform to the underlying assumptions of normality and homoskedasticity.

42. Hickok's (1989) estimate of the price elasticity of Japanese imports is lower still, at -0.4. She argues that this low elasticity reflects the predominance of raw materials in Japanese imports, and that if the composition of Japanese imports were the same as the composition of U.S. imports, the aggregate elasticity would be nearly twice as great. On this basis, the expanding share of manufactured goods in Japanese imports in recent years suggest that the price elasticity would be rising.

Table 5

Long-run Coefficient Estimates for Japan Trade
(t-statistics in parentheses)

Trade Volumes

	EXPORTS	IMPORTS
Income	1.06	1.03
	(12.4)	(7.8)
Relative Prices	-0.80	-0.73
	(-1.5)	(-6.3)
Rho		0.56
$\bar{R}^2$	0.99	0.98
Jarque-Bera	0.79	0.34
Serial Independence	0.99	0.06
ARCH	0.10	0.91
Sample	1976:2-1992:2	1976:4-1992:2

Trade Prices

	EXPORTS	IMPORTS
Domestic Labor Costs	0.61	
	(2.2)	
Commodity Prices in ¥	0.34	0.33
	(5.0)	(4.1)
Foreign Prices in ¥	0.15	
	(1.7)	
Foreign Labor Costs in ¥		0.78
		(6.1)
Rho	0.83	0.85
$\bar{R}^2$	0.98	0.98
Jarque-Bera	0.24	0.60
Serial Independence	0.73	0.87
ARCH	2.54	0.88
Sample	1975:3-1992:2	1974:2-1992:2

relative shares of labor and raw materials as inputs into Japanese manufacturing.[43] For the import price equation the unconstrained coefficients came out quite close to the constraints that we had intended to impose. As in the U.S. case, income variables were uniformly insignificant Pin the Japanese price equations and were dropped.

The results shown in the table are consistent with full pass-through of exchange rate changes to import prices. In fact, the sum of the coefficients on the exchange rate (which appears in both the unit labor cost and commodity price terms) exceeds data 1.0. This result may be attributable, in part, to some (small) degree of responsiveness of world commodity prices to fluctuations in the effective yen exchange rate.[44]

For Japanese export prices, exchange rate pass-through appears to be relatively high as well. Based on the estimated coefficient on foreign price in yen minus 1.0, it appears that 85 percent of exchange rate changes are passed through into foreign currency export prices--substantially more than other studies have found. In the Japanese case, however, the exchange rate clearly has a significant effect on export prices through changes in the price of imported raw materials. Given that world commodity prices in dollars are

43. The Japanese Economic Planning Agency's Annual Report on National Accounts, 1992 (Table 5, page 224) reports that in 1985, the shares of employee compensation and raw materials as inputs into the manufacturing sector, were 16.7 percent and 8.5 percent respectively. Gross intermediate inputs from different stages of processing within the manufacturing sector accounted for nearly 60 percent of inputs, and taxes and return to capital accounted for another 15 percent.

44. To the extent that appreciation of the yen, which reduces the yen-denominated price of raw materials, stimulates Japanese demand for those commodities, their world price will rise, offsetting some of the decline associated with the appreciation. This effect is probably small in light of Japan's relatively small share of world absorption of commodities.

not significantly affected by movements in the yen/dollar exchange rate, prices of raw materials in yen tend to move very nearly proportionately to the exchange rate.[45] Accordingly, the coefficient on the commodity price term suggests that exchange rate "pass-through" could be reduced by another 30 percentage points or so through this channel, i.e., to roughly 55 percent. When the commodity price term is dropped from the equation, the coefficient on foreign prices rises to 0.43, consistent with pass-through of 57 percent. In brief, these results suggest that incomplete pass-through of exchange rates changes to Japanese export prices could be as much or more a function of the effects of those exchange rate changes on Japanese production costs as they are of strategic pricing behavior by Japanese exporters.[46]

This result is at odds with those of Marston (1990) and Ohno (1989), who concluded that the channel for exchange rates influencing export prices through their effects on prices of raw materials is relatively unimportant. A possible explanation for this discrepancy may lie somewhere in the empirical differences between industry-level analysis and aggregative analysis. Marston's analyses focused on higher-stage-of-processing industries such as machinery and transportation equipment, into which raw materials have only a very small <u>direct</u> input. Ohno considers a broader set of industries and finds that raw materials have very little direct effect in industries such as machinery and transport equipment, but significant effects in lower-stage industries such as primary metals and chemicals. Our aggregative analysis,

45. The correlation between the dollar commodity price index and the dollar yen exchange rate over the sample period is -0.21.

46. In our review of the literature in preceding sections we noted several studies that had raised this issue.

which produces results consistent with input-output coefficients for the overall Japanese manufacturing sector, may well be giving more weight to direct effects at lower levels of processing than the industry-level analysis produces.[47] If this aggregative result holds up, it nevertheless does not negate Marston's and Ohno's findings of significant pricing-to-market behavior by Japanese firms. The prices of exports were found to be significantly more sensitive to changes in exchange rates than domestic Japanese prices for the same categories of goods (which would have been subject to the same changes in costs). Similarly, Gagnon and Knetter (1992) found the prices of identical Japanese exports to different foreign markets to be strongly related to exchange rate movements between those markets.

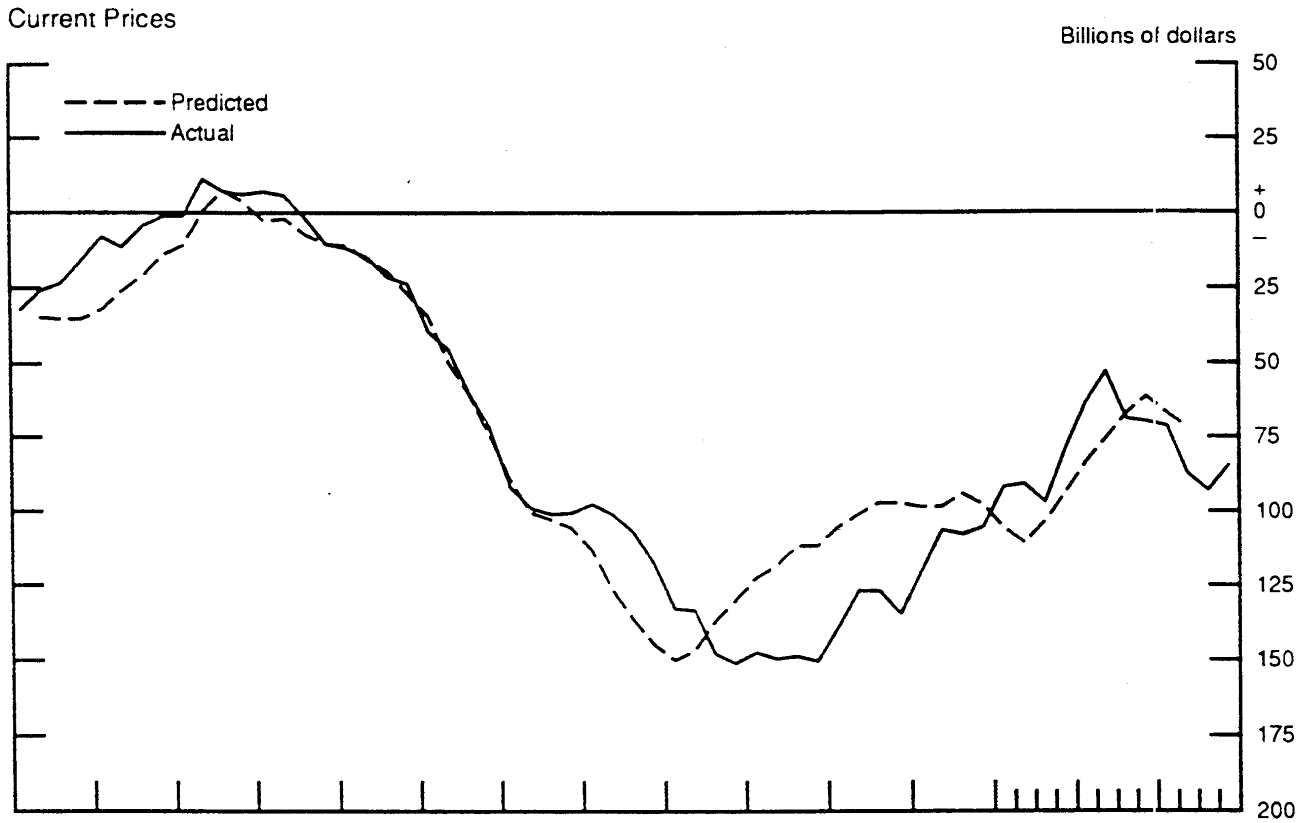
Whatever the principal reason for incomplete pass-through in the case of Japanese exports, its mere existence weakens the link between exchange rate changes and changes in Japan's real trade balance. With 60 percent pass through and an export price elasticity of -0.8, a 10 percent across-the-board appreciation of the yen results in less than a 5 percent decline in Japan's real exports. Of course nominal exports (measured in yen) fall noticeably more because of the decline in the yen price of exports associated with the incomplete pass-through of the appreciation.

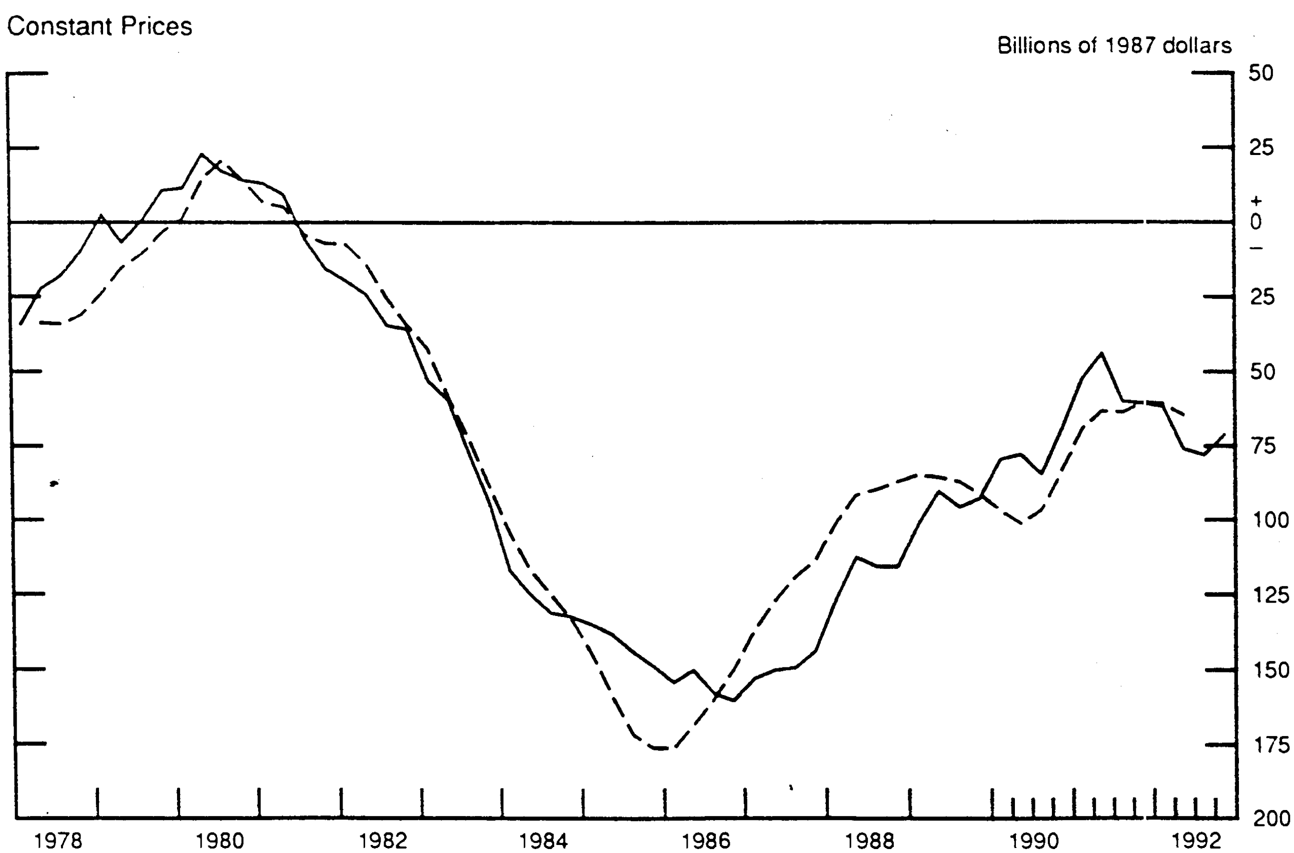
Model Simulations. To evaluate the performance of the estimated partial trade balance equations we use dynamic simulations to generate predictions for trade volumes and prices. Chart 5 compares actual and predicted values for the U.S. partial trade balance in current prices (top

47. This explanation is not fully satisfying, however, because, in principle, the effects of raw material prices at early stages of processing should be reflected in the prices of inputs into higher stages.

Chart 5

U.S. Partial Balance of Trade*





*Exports exclude agric. and computers; imports exclude oil and computers.

panel) and constant prices (bottom panel). Inspection of the results suggest a close fit until 1984. During the mid-1980s, the model predicted a faster turn around in the deficit than actually occurred (in both nominal terms and real terms), resulting in significant over-prediction of the balance for several years. This episode--and the failure of the deficit to respond quickly to the sharp decline in the dollar--generated considerable interest in the "persistence" of the U.S. external deficit. With the significant narrowing of the deficit in the latter 1980s, however, the model has been much more "on-track."[48]

Chart 6 shows the results of simulations with the same equations that were used for Table 4 and Chart 5, but estimated through 1985:Q2 instead of 1992:Q2 (that is, based on data ending just before the turning-point in the U.S. external balance). The elasticity estimates obtained for the truncated sample period were very similar to those for the full sample, and, as indicated in Chart 6, the model's post-sample predictions for the 1980s were almost as accurate as the in-sample predictions shown in Chart 5.

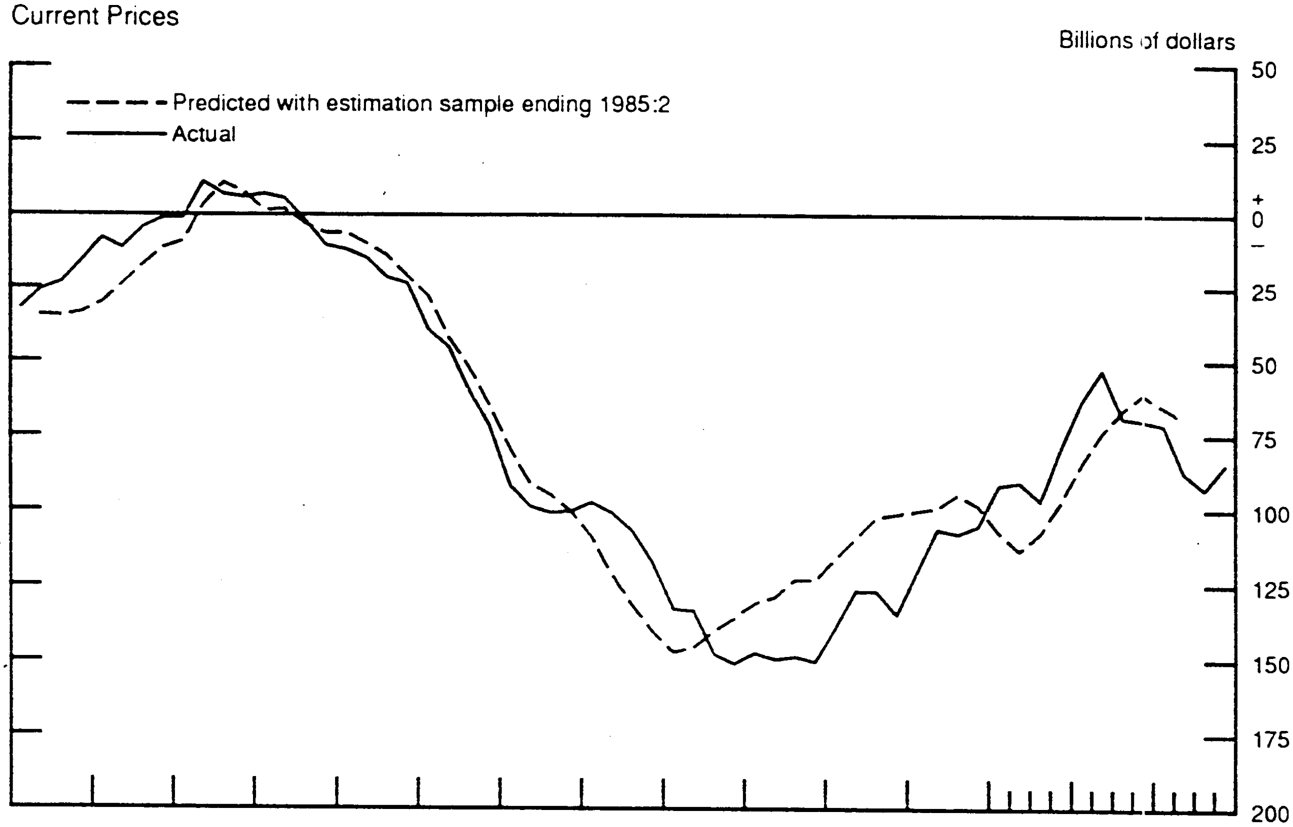
Similar analysis is presented for the Japanese trade equations in Chart 7. Those equations follow the overall swing in Japan's external balance over the past eight years reasonably well, but they tended to underpredict the

48. Bryant et. al. (1988) found that a variety of different conventional model of the U.S. current account performed quite well over he period 1980-86, and the ex-ante predictions of many of those models for the remainder of the 1980s were fairly accurate as well. Marquez and Ericsson (1993) did an intensive evaluation of the predictive accuracy of alternative trade models during 1985-87, and they concluded that the conventional model poorly relative to both its own measure of uncertainty and to the performance of time-series models during that period. Based on analysis of the model's performance over a longer (and more recent) period, Lawrence (1990), Cline (1991), and Krugman (1991) conclude that the conventional model has held up reasonably well.

Chart 6

Ex-post Forecast of U.S. Partial Balance of Trade

Current Prices



Constant Prices

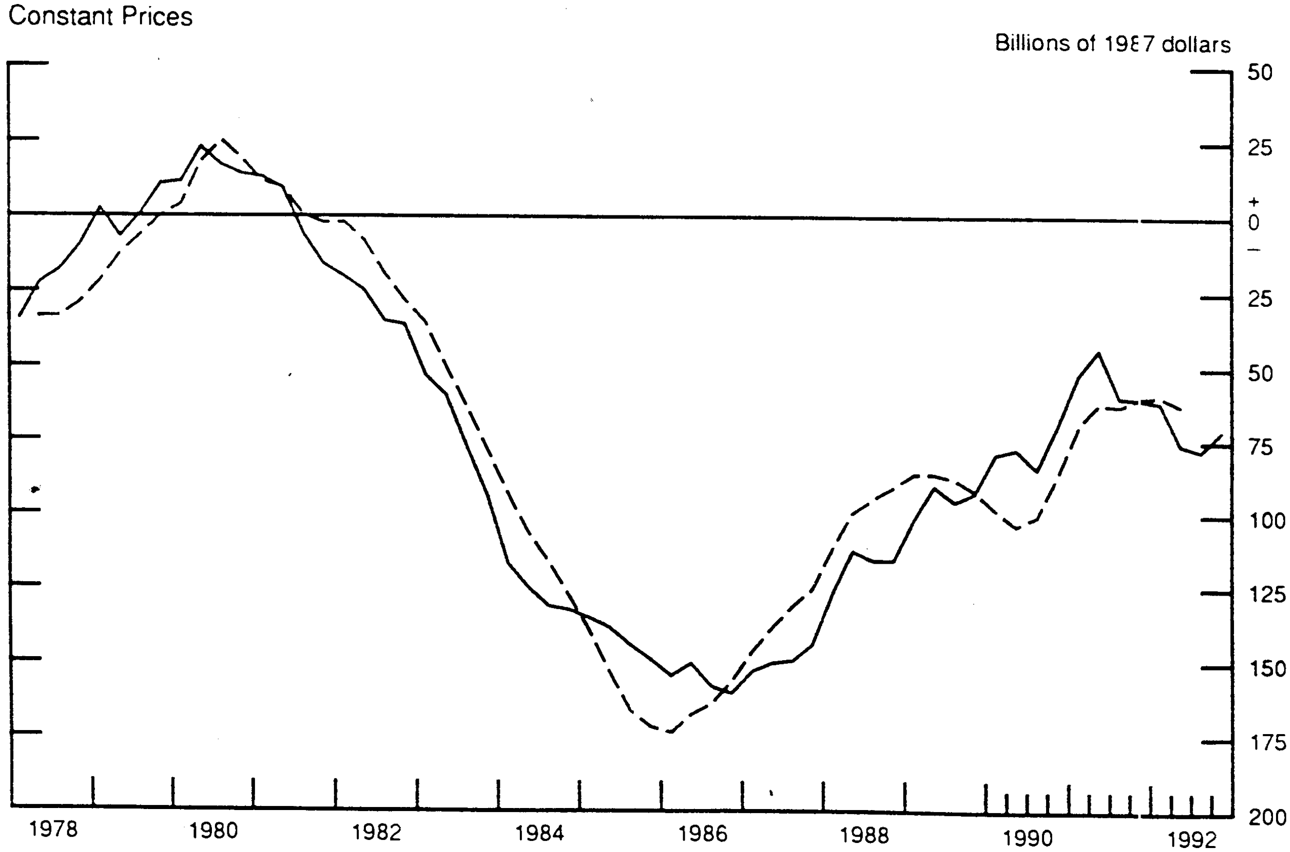
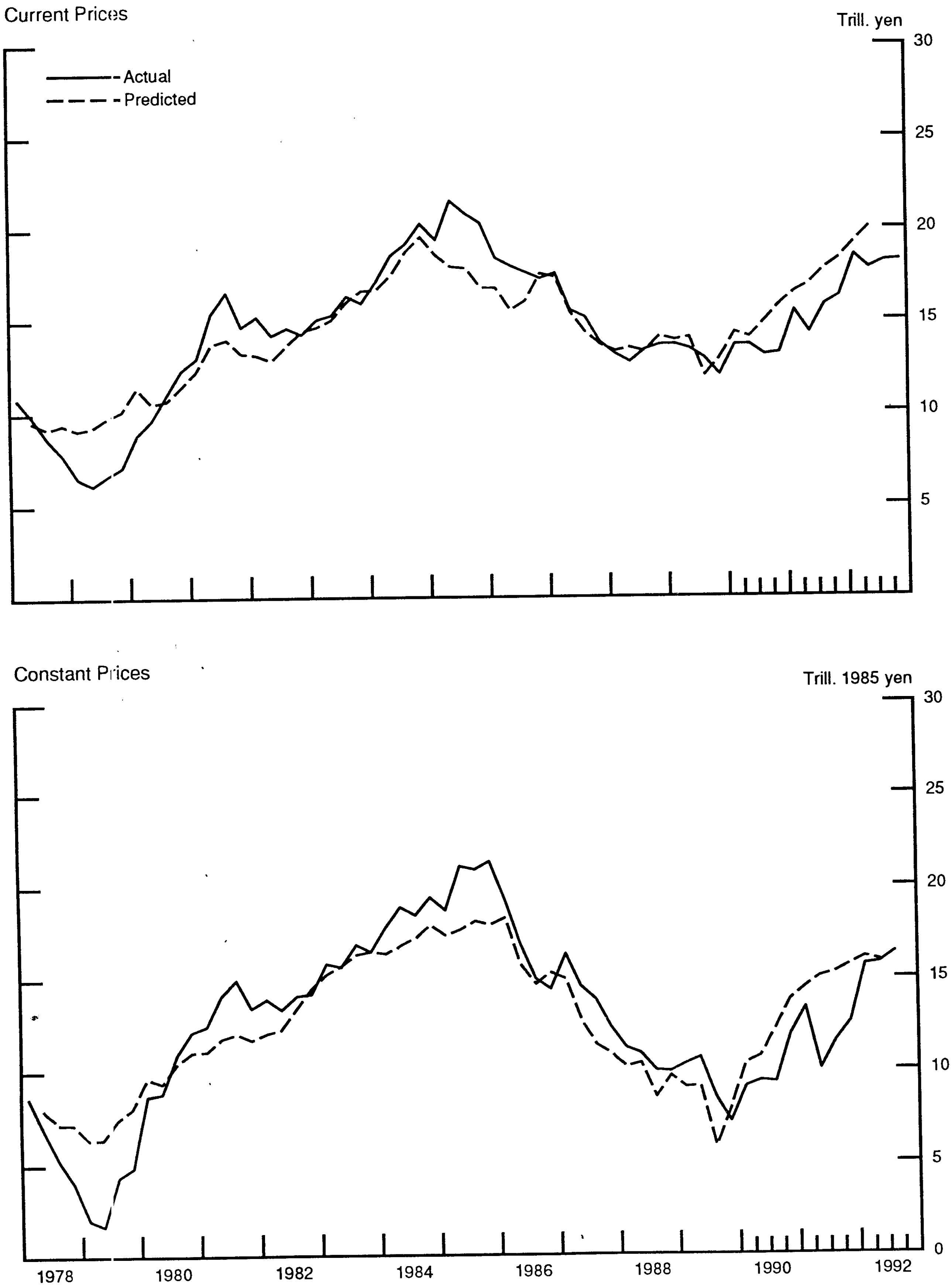


Chart 7

Japanese Non–oil Balance of Trade



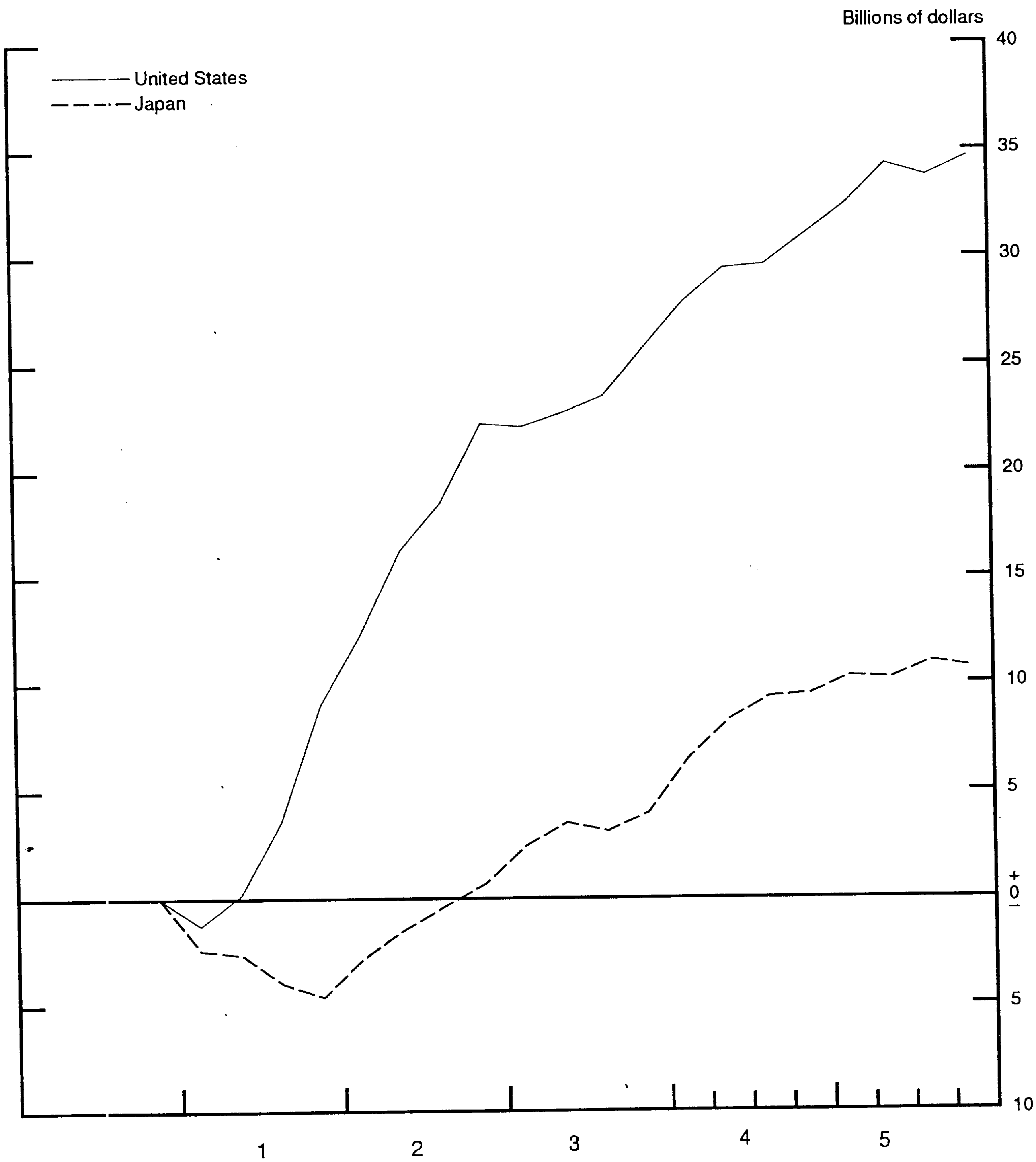
Japanese surplus during the mid-1980s and they have tended to overpredict that surplus in recent years.

In both the U.S. and Japanese cases, the presence of sizeable and persistent prediction errors for periods of up to several years suggests that there is ample room for further refinement of the conventional model. Problems in measuring prices and quality and the presence of factors other than income and relative prices that affect demand are candidates for further investigation.

Chart 8 shows the "J-curves" produced by our estimated equations for the partial trade balances of the United States and Japan. These results were obtained, in each case, by shocking the country's weighted average exchange rate to produce an immediate and sustained 10 percent depreciation of the domestic currency relative to its baseline path. The simulation was run over the period 1985 - 1989. Both countries show the conventional "J" response, with the trade balance falling initially as import prices rise and rising thereafter as real net exports respond positively to the depreciation of the dollar with a lag. The initial decline in the United States is quite small, however, reflecting the relatively low (55 percent) pass-through of the depreciation to import prices. In the Japanese case, the initial decline is much more prolonged, reflecting the very high import pass-through coefficient (in excess of 100 percent) in the Japanese case. The Japanese trade balance does not respond positively to the depreciation until about 7 quarters after the shock is imposed. After five years, the 10 percent depreciation of the yen has raised the trade balance a little more than $10 billion. In the U.S. case, the depreciation of the dollar raises the trade balance nearly $35 billion. The longer-term effect is larger in the U.S. case than in the

Chart 8

Partial Trade–balance Response to a 10% Depreciation



Japanese case partly because the value of U.S. trade was greater than that of Japanese trade over the simulation period and partly because more importantly because the sum of the estimated price elasticities for imports and exports is larger for the United States than for Japan.

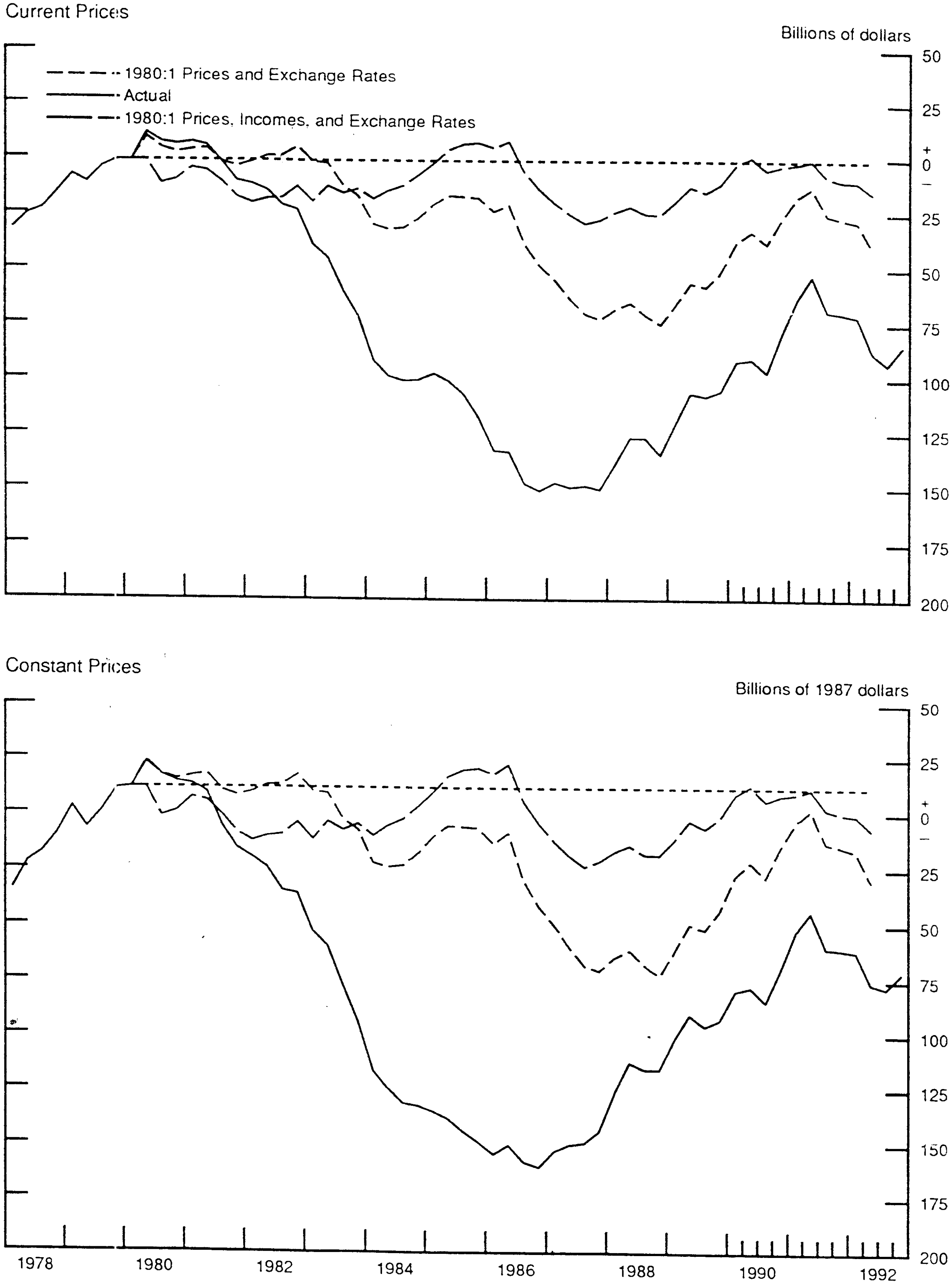
Chart 9 presents two more counterfactual simulations designed to provide a partial-equilibrium accounting of the contribution of changes in relative prices and incomes to movements in the U.S. partial trade balance since 1980. The dashed line (in both the top and bottom panels) shows the model's prediction of the path the trade balance would have followed if all prices and exchange rates had remained unchanged from their levels in 1980:Q1. The distance between the actual balance and the dashed line can be viewed as the "contribution" of changes in relative (and absolute) prices to the widening of the deficit after 1980.[49] Movements in prices and exchange rates accounted for most of the widening of the real partial trade balance between 1980 and 1986 (the distance between the actual balance and the horizontal line). By 1988-1989, after the dollar had reversed its earlier appreciation, the relative price effect accounted for less than half of the net widening of the deficit from its 1980 level. In 1991, however, it again accounted for most of the gap.

The other factor affecting the external balance was of course relative income growth. The other line the chart shows the model's prediction of the path the partial trade balance would have followed if in addition to all prices remaining unchanged, U.S. and foreign real incomes had remained at

49. Movements in both absolute and relative price levels influence the nominal trade balance, but only relative prices directly effect the real trade balance.

Chart 9

Counterfactual Simulations for U.S. Partial Balance of Trade



Dotted line equals 1980:1 value

their 1980 levels. The gap between that line and the dashed line can be viewed as the contribution of relative (and absolute) income growth.[50] The income effect reached a maximum in about 1988 as U.S. income had grown relatively rapidly to that point.[51] Beyond 1988, however, when U.S. growth slowed noticeably and growth abroad remained strong, the income effect receded sharply. The income effect has begun to widen again since mid-1991 as the U.S. economy has been recovering from recession and other major industrial countries on average have been sliding into recession.

A striking feature of this chart is the persistence of a significant relative price effect throughout the period even though the dollar had returned to its 1980 level by the end of 1987. Much of the persistent relative price effect on the real trade balance after 1988 can be attributed to imports. As we saw in Chart 1, contrary to movements in nominal and real exchange rates, the relative price of U.S. imports has remained significantly below its 1980 level. This result suggests a somewhat different explanation for the "Lawrence-Krugman" paradox than those posed by Lawrence (1990) and Cline (1991).[52]

50. The gap between horizontal line and the scenario holding all prices and incomes unchanged can be viewed as the "model error."

51. The income effect was of course magnified by gap between the income elasticities for U.S. imports and exports. As Hooper (1990, 1991) has argued, these "income" effects could well reflect other factors. Nevertheless, it is noteworthy that they are dominated for most of the period shown in Chart 9 by the relative price effects.

52. See also Krugman (1991) and Hooper's comments on Lawrence (1990) and Cline (1991) for a discussion of this issue. The Lawrence-Krugman paradox asks why the U.S. external deficit, by 1989-90, had not returned to its 1980 level after the dollar returned to its 1980 level. Lawrence explains the paradox in terms of the Houthakker-Magee result; Cline explains it in terms of errors in the measurement of the real exchange rate -- on some measures

(Footnote continues on next page)

Chart 10 shows a similar set of simulations for Japan. In this case we held variables unchanged from their levels at the beginning of 1985, which coincided with a local low point for the yen's real exchange rate. The chart indicates that most of the narrowing of Japan's partial trade balance over the latter 1980s can be attributed to the sharp appreciation of the yen in real terms. Relative incomes also contributed to the narrowing of the deficit, but that effect was generally much smaller than the relative price effect for most of the period.[53] The price effect narrowed substantially towards the end of the period, even though the yen was still significantly above its 1985:Q1 level in real terms and the relative price of Japanese imports was well below its 1985:Q1 level. This result can be attributed to the net decline in the relative price of Japanese exports (see Chart 3) and the fact that the estimated price elasticity of exports exceeds that of imports for Japan.

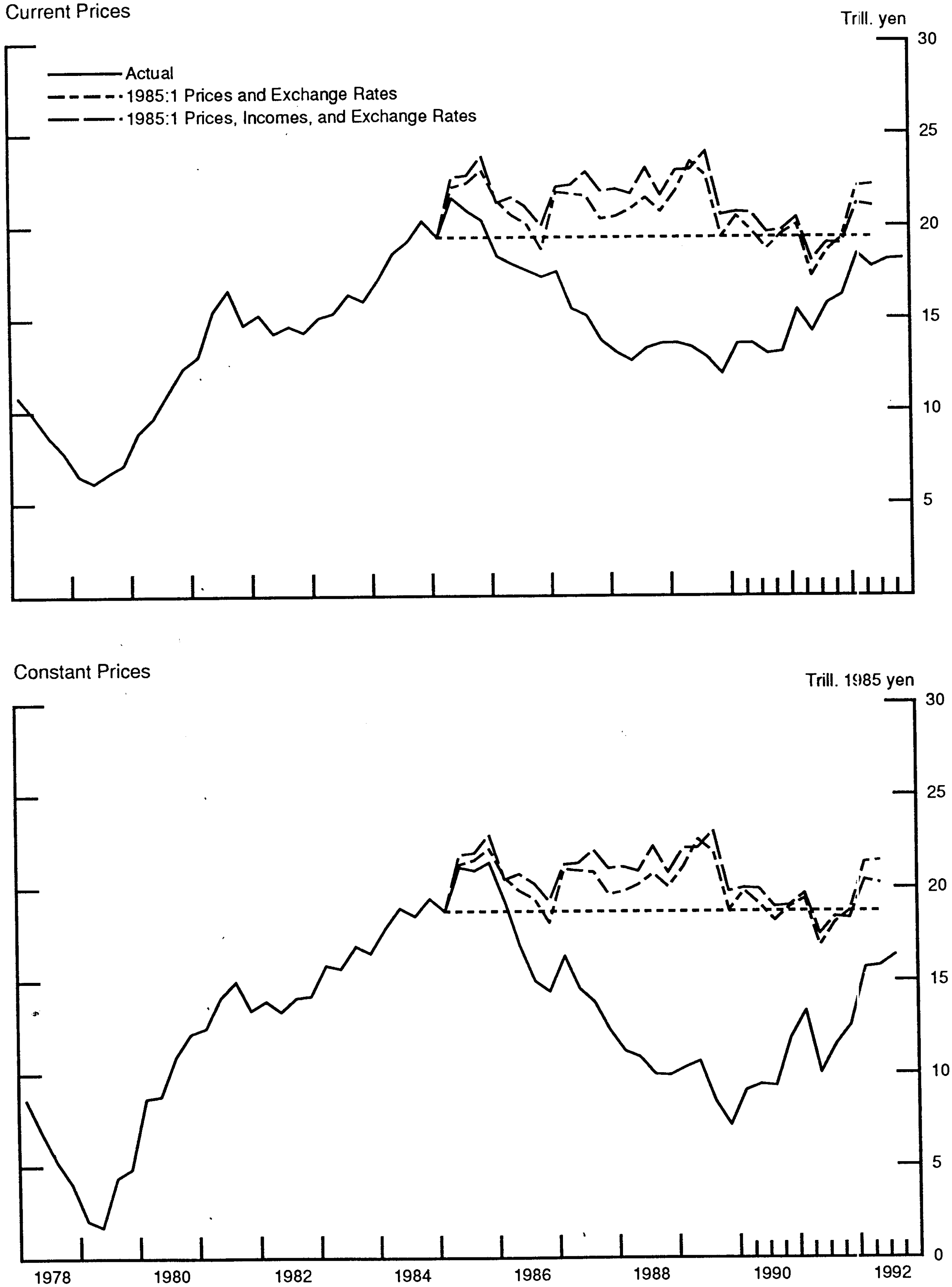
Further investigation in this area should test to see how sensitive these results are to alternative measures of the relative prices of Japanese exports and imports.

(Footnote continued from previous page)
the dollar's real exchange rate has not returned all the way to its 1980 level.

53. These relatively small role for incomes stems from the similarity of income elasticities for exports (1.1) and imports (1.2) combined with the similarity in the growth rates of Japan's income and Japan's trade partners as whole.

Chart 10

Counterfactual Simulations: Japanese Non–oil Balance of Trade



Dotted line equals 1985:1 value

V. Conclusions

First, the conventional partial-equilibrium model of the trade balance has performed generally fairly well in predicting the path of the U.S. and Japanese external balance over the past decade. For the United States, the model went off-track somewhat for up to several years during the mid-1980s, but has come back on track more recently.

Second, in a partial-equilibrium setting, exchange-rate changes have a significant and substantial influence on movements external balances. This view is supported by a fairly massive empirical literature focusing on the estimation of price elasticities in trade, by casual inspection of the data, and by our own econometric estimates of trade elasticities--which are roughly in line with the mean of estimates obtained by others. The only notable evidence to the contrary, based on estimates of single-equation models of the trade balance, does not significantly challenge the conventional result, in our view.

Third, estimates of price elasticities reported in studies using data primarily for the floating exchange rate period (since 1973) are generally smaller than those for studies based primarily on earlier data for the Bretton Woods period. This observation lends some support to the view that increases in exchange rate volatility have reduced the sensitivity of trade flows to movements in exchange rates.

Fourth, with respect to international comparisons, Japanese real trade flows appear to be considerably less responsive to exchange-rate changes than U.S. real trade flows, and this difference can be traced only in part to evidence that Japanese exporters and U.S. exporters differ in the extent to which they pass-through exchange-rate changes to the foreign-currency prices of their exports. The robustness and reasons for this result should be explored further. Can the counterpart of relatively high U.S. price elasticities (or relatively low Japanese elasticities) be found in the trade of other countries?

Fifth, a related question has to do with how best to measure (and capture in trade demand equations) the effects of changes in relative prices or price competitiveness. Various available measures of real exchange rates show widely different movements over relatively brief periods of time.

Sixth, two especially notable, even paradoxical, developments include the net decline in the relative price of Japanese exports over the past ten years in the face of a sharp appreciation of the yen, and the comparative stability of the relative price of U.S. imports (excluding oil and computers) over roughly the same period in the face of a significant depreciation of the dollar against foreign currencies (weighted by shares in U.S. imports). These two developments are no-doubt interrelated to some degree. And the second, in particular, is consistent with, but does not necessarily confirm, the presence of hysteresis.

Seventh, the substantial literature on exchange rate pass-through that has sprouted over the past decade has contributed some interesting new theoretical insights, but probably has not greatly affected empirical estimates of the effect of exchange rates on import and export prices.

Finally, Japanese exporters tend to pass-through significantly less of any given percentage exchange rate change than U.S. exporters. That difference is attributable in part to the greater sensitivity of Japanese production costs to exchange rate changes--Japanese export prices fall when the yen appreciates because the prices of petroleum and other raw materials fall in Japan with the appreciation of the yen.

Appendix A

Real Exchange Rates, Relative Prices, and the Terms of Trade.

As noted in the text, a variety of alternative measures of relative prices and real exchange rates have been used to model trade flows and external balances. However, the alternative measures are far from uniform, and can show widely varying movements over time. The purpose of this appendix is provided a brief analysis of the conceptual relationships among relative prices, real exchange rates, and the terms of trade and to document how widely these various series have differed empirically over the past two decades for both the United States and Japan. A more comprehensive analysis of the theoretical relationships among alternative measures of real exchange rates is presented in Marston (1987). Marquez (1992) provides a detailed empirical analysis of several different measures of real exchange rates and their performance in U.S. trade equations.

To begin with the conceptual relationships among the measures, from equations (6), (8), and (18) in Section II, the relative price of imports, inverted, is defined:

$$\text{(A1)}\quad P/P_m = S\cdot[\tau P_T + (1-\tau)P_N]/P_T^*$$

where the variables are defined in Section II, and where we continue with the convention of a "two-country" world comprised of the home country and the foreign country (or rest of world). From equations (7) - (9) in Section II, the relative price of exports is defined:

$$\text{(A2)}\quad S\cdot P_T/P^* = S\cdot P_T/\ [\tau^* P_T^* + (1-\tau^*)P_N^*]$$

The terms of trade is defined:

(A3) $P_T/P_m = S \cdot P_T/(P_T^*)$

The <u>real exchange rate</u> is generally defined in terms of the relative levels of broad national price indexes or labor cost indicators. One such measure is the ratio of output prices in the two countries:

(A4) $S \cdot P/P^* = S \cdot [\tau P_T + (1-\tau)P_N]/[\tau^* P_T^* + (1-\tau^*)P_N^*]$

Another measure of the real exchange rate is the ratio of consumer prices (P_c) in the two countries:

(A5) $S \cdot P_c/P_c^* = S \cdot [\theta P_T + \omega P_N + (1-\theta-\omega)P_T^*/S]/[\theta^* P_T^* + \omega^* P_N^* + (1-\theta^*-\omega^*)S \cdot P_T]$

where θ, ω, and $1-\theta-\omega$, are the shares of home tradables, home nontradables, and imports in home consumption. (The foreign price index is defined similarly.)

Yet another frequently used measure of the real exchange rate is the ratio of unit labor costs (ULC):

(A6) $S \cdot ULC/ULC^*$

Relative unit labor costs are generally defined in terms of unit labor costs in the manufacturing or tradables sectors.

An inspection of equations (A1) through (A5) suggests that deviations among the relative prices of exports and imports, the terms of the trade and the real exchange rate will tend to be greater the greater the shares of nontradables in national outputs, the greater the differences between prices of tradables and nontradables within countries, and the greater the differences between prices of nontradables across countries. The real exchange rate measured in terms of consumer prices will deviate from that measured in terms of output prices the greater the deviation in prices of tradable goods across countries.

As Marston (1987) notes, the real exchange rate based on output (GDP) deflators is largely influenced by two factors: relative unit labor costs in tradables and the ratios of unit labor costs in tradables to nontradables in each country.

Appendix B

Data Construction and Sources

To compute weighted averages of foreign variables, including effective exchange rates, we used the following formula:

$$\text{(B1)}\quad X = \prod_i X_i^{wi}$$

where X_i is a variable specific to country i, X is aggregated across all i, and wi is the weight given to country i in aggregation. The weights used in aggregation are presented in Table B1; these include bilateral import and export weights and world trade weights.

Our data sources are listed below. Table B2 provides a guide to which of the sources was used for each individual variable.[54]

Data Sources

United States

1. Federal Reserve Bulletin
2. U.S. Bureau of Labor Statistics tapes
3. U.S. Department of Commerce, *National Income and Product Accounts*

International

4. IMF *International Financial Statistics*

Canada

54. The exchange rate indexes and foreign prices in the relative price of exports are weighted by each country's share in world exports. We prefer these weights over bilateral export weights because they allow some scope for third-country competitive effects. For example, although Germany accounts for a relatively small share of total U.S. exports, German exports compete with U.S. exports in other markets, and that third-country competition is picked up to some degree by Germany's relatively large share in world trade.

5. Canadian Statistics, *Canadian Economic Observer*

France

6. Institute National de Statistiques et Etudes Economiques, *Indices Agreg.Des Prix de Vente Industrial*
7. Institute National de Statistiques et Etudes Economiques, *Informations Rapides*

Germany

8. Deutsche Bundesbank, *Monthly Report of the Deutsche Bundesbank*
9. Deutsche Bundesbank, *Supplement to the Monthly Report of the Deutsche Bundesbank*

Italy

10. ISTAT, *Instituto Nazionale di Statistica*

Japan

11. Bank of Japan, *Economic Statistics Monthly of the BOJ*
12. Economic Planning Agency of Japan, *Japanese Economic Indicators*

Mexico

13. Bank of Mexico, *Indicadores Economicos*
14. Bank of Mexico, *Avance de Informacion Economica*

Taiwan

15. Central Bank of China, *Financial Statistics Monthly*
16. Central Bank of China, *National Income in Taiwan Area of the Republic of China*

United Kingdom

17. Central Statistics Office, *Monthly Digest of Statistics*

Table B2

Data Sources by Variable and Country

	Country and Source Number[55]									
	CA	FR	GE	IT	JA	KO	MX	TA	UK	US
Exchange Rate	1	1	1	1	1	1	1	1	1	1
Export Price			9		12					1
Export Value			8		12					1
Import Price			9		12					1
Import Value			9		12					1
GDP	5	7	9	10	12	4	14	16	17	3
GDP Deflator	5	7	9	10	12	4	14	16	17	3
PPI, Manuf.	5	7	9	10	12	4	13	15	17	2
ULC, Manuf.	4	4	4	4	4	2	13	2	4	4
WPI, Raw Matls.					11					
World. Commod. Price	4									

55. Abbreviations: CA = Canada, FR = France, GE = Germany, IT = Italy, JA = Japan, KO = Korea, MX = Mexico, TA = Taiwan. Numbers correspond to the attached list of references.

References

Ahluwalia, Isher and Ernesto Hernández-Catá, "An Econometric Model of U.S. Merchandise Imports Under Fixed and Fluctuating Exchange Rates, 1959-73," IMF Staff Papers, 22, 1975, 791-824.

Alterman, William, "Price Trends in U.S. Trade: New Data, New Insights," in P. Hooper and J. D. Richardson, eds., International Economic Transactions: Issues in Measurement and Empirical Research, Chicago: University of Chicago Press, 1991.

Baldwin, Richard, "Some Empirical Evidence on Hysterisis in Aggregate U.S. Import Prices," National Bureau of Economic Research, Working Paper Series No. 2483, 1988.

_____, "Hysteresis in Import Prices: The Beachhead Effect," American Economic Review, 78, 1988, 773-785.

Baldwin, Richard and Paul Krugman, "Persistent Trade Effects of Large Exchange Rate Shocks," Quarterly Journal of Economics, 104, 1982, 635-654.

Bergstrand, Jeffrey H, "U.S.-Japan Trade: Predictions Using Selected Economic Models," Federal Reserve Bank of Boston New England Economic Review, May-June 1986.

Blecker, Robert, A, Beyond the Twin Deficits, New York: M.E. Sharpe,1992.

Branson, William, "A Disaggregated Model of the U.S. Balance of Trade," Staff Studies (Board of Governors of the Federal Reserve System: Washington, DC), 1968.

_____, "The Trade Effects of the 1971 Currency Realignments," Brookings Papers on International Economics, No. 1, 1972, 15-65.

Branson, William and Nikolaos Monoyios, "Factor Inputs in U.S. Trade," Journal of International Economics, 7, 1977, 111-132.

Branson, William and Richard C. Marston, "Price and Output Adjustment in Japanese Manufacturing," National Bureau of Economic Research, Working Paper Series, No. 2878, 1989.

Bryant, Ralph C., "The U.S. External Deficit: An Update,' Brookings Discussion Papers in International Economics, 1988.

Bryant, Ralph C. and Gerald Holtham, "The U.S. External Deficit: Diagnosis, Prognosis, and Cure," Brookings Institution, Brookings Discussion Papers in International Economics No. 55, 1987.

Bryant, Ralph C., Gerald Holtham, and Peter Hooper, External Deficits and the Dollar: The Pit and the Pendulum, Washington, D.C.: Brookings Institution, 1988.

Burda, Michael C. and Stefan Gerlach, "Intertemporal Prices and the U.S. Trade Balance," American Economic Review, 82, 1992, 1234-1253.

Caves, Richard E., "Exchange-Rate Movements and Foreign Direct Investment in the United States," in D.R. Audretch and M.P. Claudon, eds., The Internationalization of U.S. Markets, New York: New York University Press, 1990.

Caves, Richard E., Jeffrey A. Frankel, Ronald W. Jones, World Trade Payments: An Introduction, fifth ed., Glenview: Illinois, Scott, Foresman and Company, 1990.

Chang, Tse Chun, "International Comparison of Demand for Imports," Review of Economic Studies, 13, 1946, 53-67.

Clarida, Richard, "Co-integration, Aggregate Consumption, and the Demand for Imports," Columbia University, mimeograph., 1991.

_____, "Current Account, Exchange Rates, and Monetary Dynamics in a Stochastic Equilibrium Model," Yale University, Cowles Foundation Discussion Paper 694.

Clark, Peter B., "The Effects of Recent Exchange Rate Changes on the U.S. Trade Balance, in P.B. Clark, D.E. Logue and R.J. Sweeney, eds., The Effects of Exchange Rate Adjustments, Washington, D.C.: U.S. Treasury, 1977.

Cline, William R., United States External Adjustment and the World Economy, Washington D.C.: Institute for International Economics, 1989.

_____, "U.S. External Adjustment:Progress, Prognosis, and Interpretation," in C. F. Bergsten, ed., International Adjustment and Financing, Washington, D.C.: Institute for International Economics, 1991.

Corker, Robert, "External Adjustment and the Strong Yen: Recent Japanese Experience," IMF Staff Papers, 36, 1989, 464-493.

Deppler, Michael and Duncan Ripley, "The World Trade Model: Merchandise Trade," IMF Staff Papers, 25, 1978, 147-206.

Deyak, Timothy, W. Charles Sawyer, and Richard Sprinkle, "An Empirical Examination of the Structural Stability of Disaggregated U.S. Import Demand," Review of Economics and Statistics, 71, 1989, 337-341.

Dixit, Avinash, "Entry and Exit Decisions Under Uncertainty," Journal of Political Economy, 97, 1989, 620-638.

_____, "Hysteresis, Import Penetration, and Exchange Rate Pass-Through," Quarterly Journal of Economics, 104, 1989, 205-228.

Dixit, Avinash, and Joseph Stiglitz, "Monopolistic Competition and Optimum Product Diversity," American Economic Review, 67, 1977, 297-308.

Dornbusch, Rudiger, Open Economy Macroeconomics, International Adjustment and Financing, New York: Basic Book Publishers, 1980.

______, "Exchange Rates and Prices," American Economic Review, 77, 1987, 93-106.

Dornbusch, Rudiger and Stanley Fischer, "Exchange Rates and the Current Account," American Economic Review, 70, 1980, 960-971.

Eckstein, Otto and G. Fromm, "The Price Equation," American Economic Review, 68, 1968, 1159-1183.

Ericsson, Neil R. and Jaime Marquez, "Encompassing the Forecasts of U.S. Trade-balance Models," Review of Economics and Statistics, 75, 1993, 19-31.

Feenstra, Robert C., "Symmetric Pass-Through of Tariffs and Exchange Rates Under Imperfect Competition: An Empirical Test," Journal of International Economics, 27, 1989, 25-45.

_____, "New Goods and Index Numbers: U.S. Import Prices," National Bureau of Economic Research, Working Paper Series No. 3610, 1991.

Fisher, Eric, "A Model of Exchange Rate Pass-Through," Journal of International Economics, 26, 1989, 119-137.

Frankel, Jeffrey A., "Ambiguous Policy Multipliers in Theory and in Empirical Models," in R. Bryant, D. Henderson, G. Holtham, P. Hooper and S. Symansky, eds., Empirical Macroeconomics for Interdependent Economies, Washington, D. C.: Brookings Institution, 1988.

Frenkel, Jacob A. and Assaf Razin, "The Mundell-Flemming Model A Quarter Century Later," IMF Staff Papers, 34, 1987, 567-620.

Frenkel, Jacob A. and Assaf Razin, Fiscal Policies and the World Economy, Cambridge: MIT Press, 1987.

Froot, Kenneth and Paul Klemperer, "Exchange Rate Pass-through When Market Share Matters," American Economic Review, 79, 1989, 637-653.

Froot, Kenneth A. and Jeremy C. Stein, "Exchange Rates and Foreign Direct Investment: An Imperfect Capital Markets Approach," Quarterly Journal of Economics, 106, 1991, 1191-1217.

Gagnon, Joseph E. and Michael M. Knetter, "Markup Adjustment and Exchange Rate Fluctuation: Evidence from Panel Data on Automobile Exports," Federal Reserve Board, International Finance Discussion Papers No. 389, 1990.

Geraci, Vincent and Wilfred Prewo, "Bilateral Trade Flows and Transport Costs," Review of Economics and Statistics, 59, 1977, 67-74.

Giovannini, Alberto, "Exchange Rates and Traded Goods Prices," Journal of International Economics, 24, 1988, 45-68.

Goldstein, Morris and Mohsin Khan, 1978, "The Supply and Demand for Exports: A Simultaneous Approach," Review of Economics and Statistics, 60, 1978, 275-286.

_____, "Income and Price Effects in Foreign Trade," in R. Jones and P. Kenen, eds., Handbook of International Economics, vol. 2, Amsterdam: North-Holland, 1985.

Goldstein, Morris, Mohsin Khan, and Lawrence Officer, "Prices of Tradeable and Nontradeable Goods in the Demand for Total Imports," Review of Economics and Statistics, 62, 1980, 190-199.

Gregory, R.G., "United States Imports and Internal Pressure of Demand: 1948-1968," American Economic Review, 61, 1971, 28-47.

Haberler, Gottfried, "The Market for Foreign Exchange and the Stability of the Balance of Payments: A Theoretical Analysis," Kyklos, 3, 1949, 193-218.

Harberger, Arnold, "A Structural Approach to the Problem of Import Demand," American Economic Review, 43, 1953, 148-159.

Harberger, Arnold, "Currency Depreciation, Income, and the Balance of Trade," Journal of Political Economy, 58, 1950, 47-60.

Haynes, Stephen and Joe Stone, "Secular and Cyclical Responses of U.S. Trade to income: An Evaluation of Traditional Models," Review of Economics and Statistics, 65, 1983, 87-95.

Heien, Dale, "Structural Stability and the Estimation of International Import Price Elasticities," Kyklos, 21, 1968, 695-711.

Helkie, William and David H. Howard, "External Adjustment in Selected Developing Countries in the 1990s," Federal Reserve Board, International Finance Discussion Papers no. 417, 1991.

Helkie, William and Peter Hooper, "The U.S. External Deficit in the 1980s: An Empirical Analysis," in R. Bryant, G. Holtham and P. Hooper, eds. External Deficits and the Dollar: The Pit and the Pendulum, Washington, D.C.: Brookings Institution, 1988.

Hikock, Susan A., "Japanese Trade Balance Adjustment to Yen Appreciation," Federal Reserve Bank of New York Quarterly Review, Autumn, 1989, 33-47.

Hikock, Susan A., Juann H. Hung, and Kurt C. Wulfekuhler, "An Expanded, Cointegrated Model of U.S. Trade," Federal Reserve Bank of New York, Research Paper #9121, 1991.

Hooper, Peter, "Forecasting U.S. Export and Import Prices and Volumes in a Changing World Economy," Federal Reserve Board, International Finance Discussion Paper No. 99, 1976.

_____, "The Stability of Income and Price Elasticities in U.S. Trade, 1975-1977," Federal Reserve Board, International Finance Discussion Paper No. 119, 1978.

_____, "International Repercussions of the U.S. Budget Deficit," Brookings Institution, Brookings Discussion Papers in International Economics No. 27, 1985.

_____, "The Dollar, External Imbalance, and the U.S. Economy," Journal of Economic and Monetary Affairs, 2, 1988, 30-54.

_____, "Exchange Rates and U.S. External Adjustment in the Short Run and the Long Run," Federal Reserve Board, International Finance Discussion Paper No. 346, 1989.

_____, "Comment" on "U.S. Current Account Adjustment: An Appraisal," Brookings Papers on Economic Activity, No. 2, 1990, 343-392.

_____, "Comment" on "U.S. External Adjustment: Progress, Prognosis, and Interpretation," in C. F. Bergsten, ed., International Adjustment and Financing, Washington, D.C.: Institute for International Economics, 1991.

Hooper, Peter and Catherine L. Mann, "Exchange Rate Pass-through in the 1980s: The Case of U.S. Imports of Manufactures," Brookings Papers on Economic Activity, No. 1, 1989, 297-329.

_____, "The Emergence and Persistence of the U.S. External Imbalance, 1980-97," Princeton Studies in International Finance, No. 65, 1989.

Hooper, Peter and J. David Richardson, International Economic Transactions: Issues in Measurement and Empirical Research, Chicago: University of Chicago Press, 1991.

Houthakker, Hendrik and Stephen Magee, "Income and Price Elasticities in World Trade," Review of Economics and Statistics, 51, 1969, 111-125.

Johansen, Soren, "Statistical Analysis of Cointegration Vectors," Journal of Economic Dynamics and Control, 12, 1988, 231-254.

Isard, Peter, "How Far Can We Push the Law of One Price?" American Economic Review, 67, 1977, 942-948.

Kasa, Kenneth, "Adjustment Costs and Pricing to Market," Journal of International Economics, 32, 1992, 1-30.

Kenen, Peter B., "Macroeconomic Theory and Policy: How the Closed Economy Was Opened," in R. Jones and P. Kenen, eds., Handbook of International Economics, vol 2, Amsterdam: North-Holland, 1985.

Khan, Mohsin and Knud Ross, "Cyclical and Secular Income Elasticities of the Demand for Imports," Review of Economics and Statistics, 57, 1975, 357-361.

_____, "The Functional Form of the Aggregate Import Demand Equation," Journal of International Economics, 7, 1977, 149-160.

Kindleberger, Charles P., International Economics, Homewood: Irwin, 1963.

Klein, Michael, "Macroeconomic Aspects of Exchange Rate Pass-through". Journal of International Money and Finance, 9, 1990, 376-387.

Knetter, Michael, "Price Discrimination by U.S. and German Exporters". American Economic Review, 79, 1989, 198-209.

_____, "Exchange Rates and Corporate Pricing Strategies," National Bureau of Economic Research, Working Paper Series No. 4151, 1992.

_____, "International Comparisons of Pricing-to-Market Behavior," American Economic Review, forthcoming 1993.

Kohli, Ulrich, Technology, Duality, and Foreign Trade, Ann Arbor: University of Michigan Press, 1991.

Krause, Lawrence, "United States Imports, 1947-1958," Econometrica, 30, 1962, 221-238.

Kravis, Irving B. and R. E. Lipsey, "Price behavior in Light of Balance of Payments Theories," Journal of International Economics, 8, 1978, 193-246.

Kreinin, Mordechai, "Price Elasticities in International Trade," Review of Economics and Statistics, 49, 1967, 510-516.

Krugman, Paul, "Adjustment in the World Economy," National Bureau of Economic Research, Working Paper Series No. 2424, 1987a.

_____, "Pricing to Market When the Exchange Rate Changes," in S.W. Arndt and J.D. Richardson, eds., Real-Financial Linkages Among Open Economies, Cambridge: MIT Press, 1987b.

_____, "Long Run Effects of the Strong Dollar," in R. Marston, ed., Exchange Rate Misalignment and International Competitiveness, NBER Conference Report, May 1987c.

_____, "Differences in Income Elasticities and Trends in Real Exchange Rates," European Economic Review, 33, 1989, 1031-1054.

_____, Exchange-Rate Instability, Cambridge: MIT Press, 1989.

_____, "Has the Adjustment Process Worked?" in C. F. Bergsten, ed., International Adjustment and Financing, Washington, D.C.: Institute for International Economics, 1991.

Krugman, Paul and Richard Baldwin, "The Persistence of the U.S. Trade Deficit," Brookings Papers on Economic Activity, No. 1, 1987, 1-43.

Lawrence, Robert, "An Analysis of the 1977 U.S. Trade Deficit," Brookings Papers on Economic Activity, No. 1, 1978, 159-190.

_____, "Imports in Japan: Closed Markets or Minds?," Brookings Papers on Economic Activity, No. 2, 1987, 517-554.

_____, "U.S. Current Account Adjustment: An Appraisal," Brookings Papers on Economic Activity, No. 2, 1990, 343-392.

_____, "Efficient or Exclusionist? The Import Behavior of Japanese Corporate Groups," Brookings Papers on Economic Activity, No. 1, 1991, 311-330.

Leamer, Edward E. and Robert M. Stern, Quantitative International Economics, Boston: Allyn and Bacon, 1970

Magee, Stephen, "Tariffs and U.S. trade," Working paper No. 14, Graduate School of Business (University of Chicago: Chicago), 1972.

Mann, Catherine L., "Prices, Profit Margins, and Exchange Rates," Federal Reserve Bulletin, June 1986.

_____, "The Effects of Aggregate Demand and Exchange Rate Shocks on the Profit Margins of Internationally Traded Goods". Presented at "Monetary Uncertainty, Financial Futures, and Economic Activity", International Futures and Commodity Institute, Geneva Switzerland, November 1986.

Marquez, Jaime, "Income and Price Elasticities of Foreign Trade Flows: Economic Estimation and Analysis of the U.S. Trade Deficit," Federal Reserve Board, International Finance Discussion Papers No. 324, 1988.

_____, "Bilateral Trade Elasticities," Review of Economics and Statistics, 72, 1990, 70-77.

_____, "The Dynamics of Uncertainty or the Uncertainty of Dynamics: Stochastic J-curves," Review of Economics and Statistics, 73, 1991, 125-133.

_____, "Real Exchange Rates: Measurement and Implications For Predicting U.S. External Imbalances," Federal Reserve Board, International Finance Discussion Papers No. 427, 1992.

_____, "The Autonomy of Trade Elasticities for Trade Among Canada, Japan, and the United States," Japan and the World Economy, 1993 (forthcoming).

Marquez, Jaime and Caryl McNeilly, "Income and Price Elasticities for Exports of Developing Countries," Review of Economics and Statistics, 70, 1988, 306-314.

Marquez, Jaime and Neil R. Ericsson, "Evaluating Trade-account Forecasts," in R. Bryant, P. Hooper, and C. Mann, eds., Empirical Evaluation of Alternative Policy Regimes, Washington D.C.: Brookings Institution, 1993.

Marris, Stephen, Deficits and the Dollar: the World Economy at Risk, Washington D.C.: Institute for International Economics, 1985.

_____, "Why No Hard Landing," in C. F. Bergsten, ed., International Adjustment and Financing, Washington D.C: Institute for International Economics, 1991.

Marston, Richard, "Income Effects and Delivery Lags in British Import Demand: 1955-67," Journal of International Economics, 1, 1971, 375-399.

_____, "Real Exchange Rates and Productivity Growth in the United States and Japan," in S. Arndt and J. D. Richardson, eds., Real and Financial Linkages among open Economies, Cambridge: MIT Press, 1987.

_____, "Pricing to Market in Japanese Manufacturing," Journal of International Economics, 29, 1990, 217-236.

Maskus, Keith, "Evidence on Shifts in the Determinants of the Structure of U.S. Manufacturing Foreign Trade, 1958-1976," Review of Economics and Statistics, 65, 1983, 415-422.

McKinnon, Ronald I., "The Exchange Rate and Macroeconomic Policy: Changing Postwar Perceptions," Journal of Economic Literature, 19, 1981, 531-557.

_____, "Money Supply versus Exchange Rate Targeting in Open Economies," mimeo, Stanford University, June 1987.

_____, "Purchasing Power Parity as a Monetary Standard," mimeo, Stanford University, August 1987.

Meade, Ellen E., "Exchange Rates, Adjustment, and the J-Curve," Federal Reserve Bulletin, 74, 1988, 633-44.

_____, "Computers and the Trade Deficit: The Case of Falling Prices," in P. Hooper and J. D. Richardson, eds., International Economic Transactions: Issues in Measurement and Empirical Research, Chicago: University of Chicago Press, 1991.

_____, "A Fresh Look at the Responsiveness of Trade Flows to Exchange Rates," for the Western Economic Association in San Francisco, July 1992.

Melick, William R., "Estimating Pass-through: Structure and Stability," Federal Reserve Board, International Finance Discussion Papers No. 387, 1990.

Mendoza, Enrique G., "The Terms of Trade and Economic Fluctuations," International Monetary Fund Working Paper, Nov. 1992

Miller, Joseph and Michele Fratianni, "The Lagged Adjustment of U.S. Trade to Prices and Income," Journal of Economics and Business, 26, 1974, 191-198.

Moffet, Michael, "The J-curve Revisited: An Empirical Examination for the United States," Journal of International Money and Finance, 8, 1989, 425-444.

Mundell, Robert A., "The Great Exchange Rate Controversy: Trade Balances and the International Monetary System," in C. F. Bergsten, ed., International Adjustment and Financing, Washington, D.C.: Institute for International Economics, 1991.

_____, "Do Exchange Rates Work? Another View," IMF Working Paper WP/91/37. April 1991.

Murphy, Robert G., "Import Pricing and the Trade Balance in a Popular Model of Exchange Rate Determination," Journal of International Money and Finance, 8, 1989, 345-357.

Murray, Tracy and Peter Ginman, "An Empirical Examination of the Traditional Aggregate Import Demand Model," Review of Economics and Statistics, 58, 1976, 75-80.

Noland, Marcus, "Japanese Trade Elasticities and the J-curve," Review of Economics and Statistics, 71, 1989, 175-179.

Obstfeld, Maurice, "Aggregate Spending and the Terms of Trade: Is there a Laursen-Meltzer Effect?," Quarterly Journal of Economics, 97, 1982, 251-270.

______, "Floating Exchange Rates: Experience and Prospects," Brookings Papers on Economic Activity, No. 2, 1985, 369-450.

Ohno, Kenichi, "Export Pricing Behavior of Manufacturing: A U.S.-Japan Comparison," IMF Staff Papers, 36, 1989, 550-579.

Orcutt, Guy, "Measurement of Price Elasticities in International Trade," Review of Economics and Statistics, 32, 1950, 117-132.

Pauls, B. Dianne, "Measuring the Foreign-Exchange Value of the Dollar," Federal Reserve Bulletin, 73, 1987, 411-422.

Persson, Torsen and Lars Svensson, "Current Account Dynamics and the Terms of Trade: Harberger-Laursen-Metzler Two Generations Later," Journal of Political Economy, 93, 1985, 43-65.

Pritchett, L., "The Real Exchange Rate and the Trade Surplus: An empirical Analysis for Non-oil Exporting LDCs," (unpublished working paper) Washington D.C.: World Bank. 1991.

Rangan, Subramanian and Robert Lawrence, "The Response of Firms to Exchange Rate Fluctuations: Piercing the Corporate Veil," Brookings Papers on Economic Activity, 1993 (forthcoming).

Razin, Assaf, "Intertemporal Optimization and the Current Account," paper presented at the Fiftieth Anniversary of Essays in International Finance, Princeton University, April 15-16, 1993.

Richardson, J. David, "Some Issues in the Structural Determination of International Price Responsiveness," in H. Glejser, ed., Quantitative Studies of International Economic Relations, Amsterdam: North-Holland, 1976.

Rose, Andrew K., "Exchange Rates and the Trade Balance," Economics Letters, 34, 1990, 271-275.

_____, "The Role of Exchange Rates in a Popular Model of International Trade: Does the Marshall Lerner Condition Hold?," Journal of International Economics, 30, 1991, 301-316.

Rose, Andrew K. and Janet L. Yellen, "Is there a J-Curve?" Journal of Monetary Economics, 24, 1989, 53-68.

Sachs, Jeffrey D., "The Current Account and Macroeconomic Adjustment in the 1970s," Brookings Papers on Economic Activity, No. 1, 1981, 201-268.

____, "The Current Account in the Macroeconomic Adjustment Process," Scandinavian Journal of Economics, 84, 1982, 147-159.

_____, "The Dollar and the Policy Mix: 1985," Brookings Papers on Economic Activity, No. 1, 1985, 117-185.

Stern, Robert, Christopher Baum, and Mark Green, "Evidence on Structural Change in the Demand for Aggregate U.S. Imports and Exports," Journal of Political Economy, 87, 1979, 179-192.

Stern, Robert, Jonathan Francis, and Bruce Schumacher, Price Elasticities in International Trade: An Annotated Bibliography, London: MacMillan, 1976.

Stockman, Alan C., "Exchange Rates, the Current Account and Monetary Policy," in W.S. Haffer and T.D. Willett, eds., Monetary Policy for a Volatile Global Economy, Washington D.C.: American Enterprise Institute Press, 1990.

Svennson, Lars and Assaf Razin, "The Terms of Trade, Spending and the Current Account: the Harberger-Laursen-Meltzer Effect," Journal of Political Economy, 91, 1983, 97-125.

Swamy, P.A.V.B. and Stephan Thurman, "Exchange Rate Episodes and the Pass-Through of Exchange Rates to Import Prices," Federal Reserve Board, Finance and Economics Discussion Papers No. 93-25, 1993.

Taplin, G., "A Model of World Trade," in R. Ball, ed., The International Linkage of National Economic Models, Amsterdam: North-Holland, 1973.

Ueda, Kazuo, "Trade Balance Adjustment with Imported Intermediate Goods: The Japanese Case," Review of Economics and Statistics, 65, 1983, 618-625.

Walter, Norbert, "German External Adjustment Since 1985," in C. F. Bergsten, ed., International Adjustment and Financing, Washington, D.C.: Institute for International Economics, 1991.

Warner, Andrew M., "Does World Investment Demand Determine U.S. Exports?" Federal Reserve Board, International Finance Discussion Papers No. 423, 1992.

_____, "Import Demand and Supply with Relatively Few Theoretical or Empirical Puzzles," Federal Reserve Board, International Finance Discussion Papers No. 433, Federal Reserve Board, 1992.

_____, "Does the U.S. Import Market Behave as a Classical Supply and Demand System: Revision", Federal Reserve Board, International Finance Discussion Papers No. 433, 1992.

Warner, Dennis and Mordechai Kreinin, "Determinants of International Trade Flows," Review of Economics and Statistics, 65, 1983, 96-104.

Wilson, John and Wendy Takacs, "Differential Responses to Price and Exchange Rate Influences in the Foreign Trade of Selected Industrial Countries," Review of Economics and Statistics, 61, 1979, 267-279.

Yadav, Gopal, "Variable Elasticities and Non-price Rationing in the Import Demand Function of Canada, 1956:1-1973:4," Canadian Journal of Economics, 10, 1977, 702-712.

Yoshitomi, Masaru, "Surprises and Lessons from Japanese External Adjustment in 1985-91," in C. F. Bergsten, ed., International Adjustment and Financing, Washington, D.C.: Institute for International Economics, 1991.

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